THE AMERICAN JOURNAL OF ROENTGENOLOGY

Editor, James T. Case, M.D., Battle Creek, Mich.

VOL. V (NEW SERIES) JUNE, 1918 No. 6

AN APPARATUS FOR QUICK AND ACCURATE LOCALIZATION ON THE SCREEN

PARTICULARLY ADAPTABLE FOR USE IN CONNECTION WITH THE SURGICAL OPERATING TABLE

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The Tube.—The apparatus to be described consists in the first place of the couch with a roentgen ray tube supported below, the latter surrounded by a protective shield, or, as in the model from which the accompanying illustrations are taken, contained in a large lead-lined box. The tube is supported by two arms which are carried outside the box by a zigzag opening. This permits of the tube being easily raised and lowered, and also allows the circulation of air by which the tube is kept cool, while at the same time no roentgen rays can pass out in this direction. (See Fig. 1.)

Fluorescent Screen and Cross Wires.—This part of the apparatus which is carried outside the tube box is attached to an upright support, and from the upper part of this support there is projected a hinged arm which can be placed horizontally over the couch or stretcher upon which the patient lies. A rack-and-pinion arrangement enables this arm and the tube below to be moved upwards and downwards together, and the distance between them is rigidly fixed and constant. Attached to this projecting arm is a square frame holding a hinged fluorescent screen. In the center of the frame two cross wires intersect (see Fig. 2), and the whole device is so arranged that the intersection of the wires is vertically above the spot on the anticathode of the tube from which the roentgen rays originate.

Centering.—The tube is first thoroughly adjusted to this position, and the final centering is done by suspending a small plumb bob from the intersection of the cross wires. The screen is closed down upon it so that the plumb bob hangs two or three inches below the bottom of the screen, and the tube is then excited and the circular shadow of the plumb bob is observed. If it so happens that the cross wires occupy a position at the center of the circular shadow of the plumb bob, the adjustment is perfect, and nothing further need be done. Should the shadow be out of the center, the supporting arm near the pillar end has two rack-and-pinion movements which enable the arm to be pushed forward across the couch or—at right angles to this movement—in line with the length

of the couch. While the shadow is being observed, these screws can be so manipulated as to bring the plumb bob in the dead center of the cross wires. This is a much simpler and quicker way of centering the tube than that of moving the tube itself. When this adjustment has been made, a small clamp is tightened, after which no displacement can occur. The adjustment once obtained, it remains constant.

Locating the Foreign Body.—With this arrangement it is quite obvious that a wounded person can be placed upon the table, the rack-and-pinion motion allowing the descent of the cross wires so that they are actually in touch with the skin, or as close as possible to it while allowing free movements. Two handles will be observed projecting from the supporting pillar; of these the observer takes hold, while, on the track below, the tube box is moved backwards or forwards in line with the length of the couch and across its breadth. In this manner the patient can be examined from top to toe. If a foreign body is detected, the apparatus is so adjusted that the shadow of this foreign body is made to appear at the intersection of the cross wires. When this adjustment has been obtained the box can be clamped to avoid displacement; the screen is hinged back, and the skin of the patient marked at the point of the cross-wire intersection. It is, of course, quite obvious that the foreign body in this position of the patient must be vertically below that particular point.

Ascertaining Depth.—To ascertain the depth at which the foreign body is lying below the cross wires is a simple matter, involving only a few adjustments after replacement of the screen. In Fig. 3 a small clamp will be noticed with the operator's foot upon it to tighten it; from this clamp an upright will be seen with a T piece, which T piece is rotated counter-clockwise, and the tube box and support displaced to the left to a precise distance of 6 cm. (See Fig. 1.) (An apparatus can

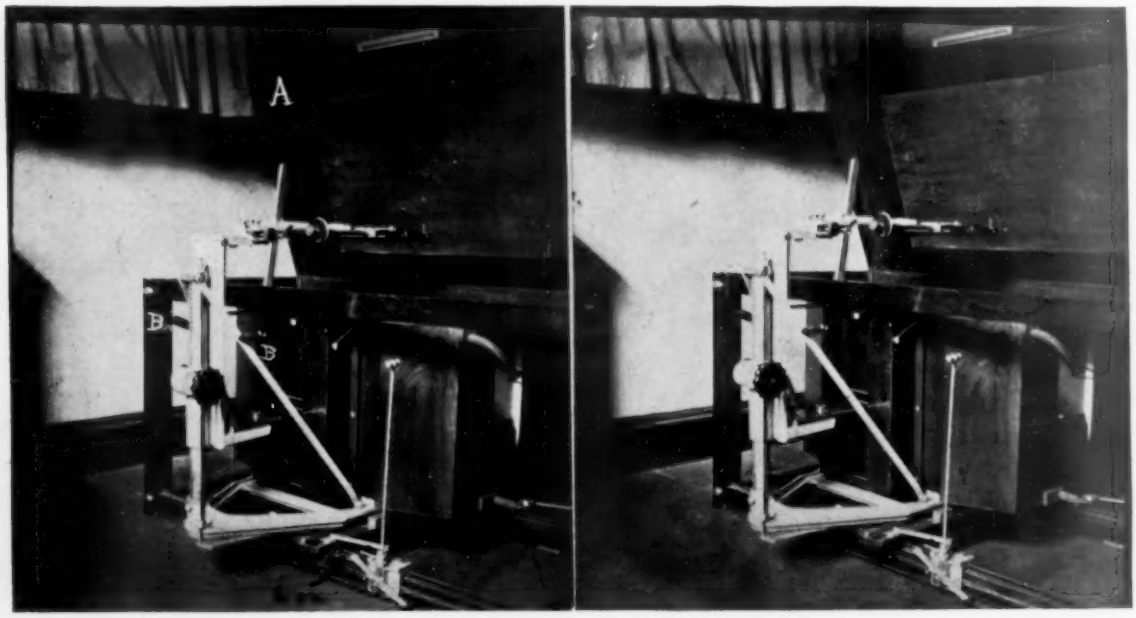

FIG. 1. GENERAL VIEW OF APPARATUS WITH COUCH FRAME, TUBE BOX AND UPRIGHT SUPPORT.

Showing (A) couch top raised and (B) handles for moving apparatus up and down.

be made to displace for any other distance that the operator may desire.) When this is done, of course, the shadow of the foreign body which had been previously accurately centered will be observed to be displaced to the right, and as the distance between the tube and the cross wires is always constant (in this case 50 cm.), the displacement of the shadow varies as the depth and can be accurately calibrated.

As a result of many experiments, I find that for easier visibility on examining the thick parts of the human body, a wire close to the surface of the screen and under the protective glass is more easily seen than the shadow of wires underneath the screen. I have, therefore, placed on the surface of the screen two fine cross wires in exact register—when the screen is in position—with the cross wires on the supporting frame. Then, to measure the displacement of the shadow, I have a very fine wire, like a fine knitting needle, which is made to travel across the screen horizontally, parallel with one of the fixed cross wires and intersecting the other. This traveling wire is attached to a nut on a two-thread screw. On the near side of this nut there is a small arrowhead indicator in contact with a calibrated scale, so that when the shadow of the displaced foreign body is observed, the little screw head can be rotated in such a manner as to make the wire travel to the position of that point in the shadow of the foreign body which originally was centered by the cross wires. It will then be found that the arrow points to a certain number, either in inches or centimeters, the latter preferably, and the depth of the foreign body can be read off immediately. It is quite easy to arrange an open scale with a multiplying gear for the traveling wire, but after trials in this direction I prefer to use the direct reading from the traveling nut, which obviates all slip, and any little error in adjusting the wire and the shadow is not therefore magnifiable on the measuring screen.

It must always be remembered that the

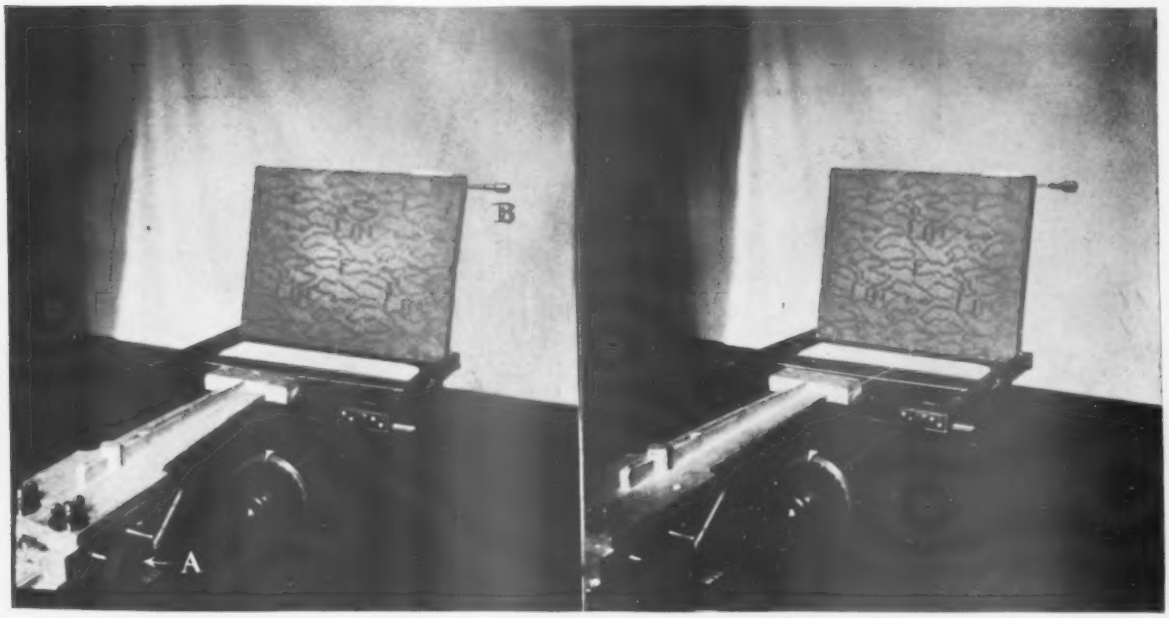

FIG. 2. HORIZONTAL ARM WITH CROSS WIRES AND SCREEN HINGED BACK.

Showing (A) screws for centering cross wires and (B) handle to rotate screw rack carrying moving wire.

distances recorded on the micrometer scale indicate the distances of the foreign body from the cross wires on the supporting frame; therefore, if the central spot marked on the screen is any distance from the cross wires, of course this distance must be subtracted from the indicated distance to give accurate depth from the marked point to the position of the foreign body.

The manipulations which I have attempted to describe, although when written they may appear complicated, can all be carried out in about ten seconds. I know of no device at the present moment which is so accurate and rapid as this.

Application to Roentgenography.—If it is desired to use this apparatus for making plates, it is quite a simple matter to make the necessary arrangements. The point where the wires intersect indicates the vertical ray. This can be placed over the area which it is desired to examine; a little mark can be made on the skin vertically below the cross wires; the horizontal arm hinged back (as shown in the illustration); and then the plate in its holder is placed as usual on the patient's skin, and a roentgenogram made, either singly or with the stereoscopic shift. I have purposely, for quick localization on the screen, made this apparatus with only one method of shift, always to the left, thus avoiding mistakes, and making the thing "fool-proof." Should it be desired, however, to make stereoscopic plates with the shift *across* the couch, it is quite easy to make a little indicator, and while the tube box is prevented by a fixed clamp from moving parallel with the length of the couch it can be moved across the couch with any displacement desired.

Use in Connection with Surgical Operating Couch.—I wish specially to point out the utility of this apparatus in connection with the operating couch which the surgeon uses for the actual removal of the foreign body. Let us suppose that the surgeon has begun his operation and has difficulty in finding the foreign body.

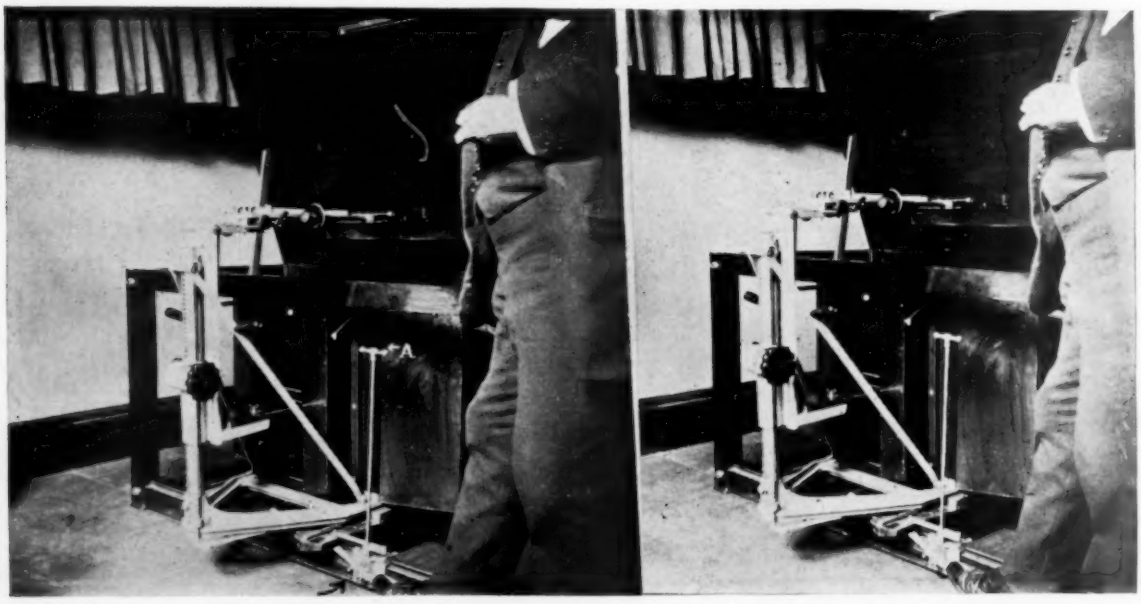

FIG. 3. FOOT CONTROL OF UPRIGHT HANDLE FOR DISPLACEMENT.

Showing (A) position of handle before displacement. In FIG. 1 handle has been turned, indicating 6 cm. displacement.

He can observe the screen by means of a hood, or the room may be darkened for a few seconds. The arm of the screen is placed horizontally and racked up so as to be quite clear of the wound, over which it can be moved without touching, and therefore need not be disinfected. The apparatus can be rapidly moved, as already described, until the shadow of the foreign body is centered, when it can be clamped and fixed. The surgeon can then introduce into the wound a little probe which he can move about until it comes vertically over the foreign body, when it may be pushed down to the bottom of the wound and held there. The shift can be made at once, and, by moving the micrometer traveling wire over the point of his probe, the surgeon can read the depth below the cross wire with the aid of a little flash lamp. He then moves the micrometer traveling wire on to the shadow, with the corresponding part of it over the part which was previously centered, and reads the depth of the foreign body. The difference between the two readings gives him at once the vertical depth of the foreign body below the point of his probe.

Use at Clearing Stations.—The accompanying stereoscopic photographs, if viewed in a small lenticular stereoscope, will show fairly well the first model of the apparatus that I have had made. Now that the general principles of the method as here described are understood by practical engineers, it seems to me they would not find it difficult to devise and construct some convenient form in which these principles would be carried out, and which could be placed under an operating couch or under a stretcher. In this way wounded men could be carried in on stretchers, examined, the position and depth of the foreign body indicated, and then each man could be rapidly removed and his place be taken by the next. At clearing stations it appears to me that this would facilitate the work enormously, and, if the operating couches had stretcher tops, should there be any difficulty at any time in extracting the foreign body, and a separate roentgen ray outfit were not available for each operating table, the patient could be carried and placed on trestles between the tube and the screen as I have already described, and the position of the foreign body quickly ascertained.

I should advise the construction of a simple apparatus of this kind, as rigidly and lightly made as necessary, and a small portable track which could be laid down anywhere in clearing stations for it to run on. This, with two trestles to support the stretcher, would enable the wounded to be carried in to the required position between tube and cross wires.

The Upright Stand.—I have here described the method as applied to patients on a horizontal couch. It is quite a simple matter to devise an apparatus to work on an upright stand.

Tube Box and Diaphragm.—I should like to emphasize the advantage of this large box for containing the tube. It has a large hinged door on the opposite side to that from which I photographed it, with a lead glass window, which can be opened and gives easy access to the tube. Further, there is complete protection to everybody who keeps out of the direct path of the rays which come from the opening in the top of the box. Moreover, for those who wish to work with very small diaphragms, I have devised a simple modification which has proved very useful. A large square opening is placed on the top of the box. Two lead plates are also provided which slide together, so that they can be closed or opened in unison. In this way a very narrow slot can be adjusted, parallel to the line of displacement of the tube box. From either end of this diaphragm there are two lead plates which also slide and meet in the middle, but are operated by separate handles, so that when a small square opening is desired opposite the intersection of the cross wires, the handle operating the two plates closes them to a slot; then the two side plates are moved

up until a very small narrow square opening is made, admitting of extremely fine observation, as the glare from the rest of the screen does not disturb the vision of the observer. Of course, after the object has been centered and the apparatus displaced to get the shadow shift, this fine diaphragm will completely eclipse the shifted shadow. Therefore, the lateral plate in the direction in which the shadow has been shifted—in this case always to the right of the observer—has to be opened until the shadow of the foreign body is seen, and then the other plate can be pushed across the center up towards it until one gets an equally small square opening for observing the shifted shadow as one had originally for observing the central shadow. This is quite easy of manipulation, and enables one to observe the central and the shifted shadow of the foreign body under the same optical conditions.

After considerable experience of this method of quick and accurate localization on the screen, I have every confidence in recommending it.

ROENTGENOLOGY IN WARFARE

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INTRODUCTION

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WASHINGTON

The following paper by J. Hall-Edwards is especially timely. It is written by a roentgenologist of ripe experience and sane judgment, and may be read with profit by surgeons as well as roentgenologists.

I wish to call particular attention to the author's plea for coöperation between the surgeon and the roentgenologist. With proper coöperation between these two the *x*-ray has rendered invaluable assistance in the present war, while without such coöperation it is valueless or even harmful.

The necessity for this harmony of effort furnishes the reason for another point insisted upon by the author—that all roentgenologists must be men with medical training. The non-medical technician cannot possibly bring to a consultation with the surgeon the experience and training necessary to give his opinions weight. The Surgeon General's Office has recognized this fact and has, from the beginning of the war, insisted that only officers of the Medical Reserve Corps, graduate physicians, should be assigned for duty as roentgenologists. The Surgeon General's Office has also recognized the necessity for thorough coöperation between the surgeon and roentgenologist. In the schools for instruction in surgery roentgenological methods are being thoroughly explained and illustrated, and in the *x*-ray schools no opportunity is lost to give to the students the surgeon's standpoint.

The American roentgenologist is anxious to profit by the experience obtained by our allies at great cost and sacrifice, and Mr. Hall-Edwards has rendered us a real service by publication of this paper calling attention to vital matters in the conduct of the *x*-ray work of the war.

I VENTURE to submit this paper in the hope that a few notes from one who has had considerable experience both in the present and South African wars, may prove of some value to my American friends who are now being brought face to face with the many difficulties which present themselves to the surgeons and roentgenologists engaged in war work.

Every roentgen department should be supervised by a trained medical officer—under no circumstances should a layman be allowed to sign a roentgenological report. Nothing is likely to be more detrimental to the future of our science than the effects which are certain to accrue if this injunction be disregarded.

There are at the present time hundreds if not thousands of *x*-ray assistants employed in the army who before the war were absolutely ignorant of the most elementary principles of *x*-ray technic. These assistants, after a few months' work in an *x*-ray department, consider themselves competent to undertake *x*-ray examinations on their own account. They were chosen for the positions they now hold chiefly on account of their having some elementary knowledge of developing and printing, and a certain number of them have gone through a short course of instruction in *x*-ray work prior to their being employed in these departments. Their knowledge, even at the end of the war, will be exceedingly limited, inasmuch as the majority of cases roentgenographed by them are essentially war cases, such as are seldom if ever met with in civil practice, so that even should they be endowed with special aptitude for observing details, their knowledge of *x*-ray procedure is extremely limited.

The interests of both the public and the profession must be safeguarded, and these assistants must be told that there is no more chance of their being able to make a living out of *x*-rays after the war (except as assistants) than there is of a navvy in the Royal Engineers being able to make a living as a consulting engineer.

Coöperation between the surgeon and the roentgenologist is essential to success. My experience as an inspector of roentgenological departments proved to me that the best work was done in hospitals where the roentgenologist was accorded his proper position, and where coöperation between himself and the surgeon was a daily practice. One of the most obvious causes of failure in the finding of foreign bodies is due to the absence of coöperation, and the fact that some surgeons refuse to coöperate results in failure and disappointment, to the detriment of the patient and the country at large.

In a few fortuitous instances, the surgeon is also a roentgenologist—such a combination should produce the best possible results in war time—failing this, the best that can happen is coöperation and consultation. Personally I would not sanction the operation for the removal of a foreign body from a vital part until a consultation had been held in the presence of the roentgenologist. In South Africa, no operation for the removal of a foreign body was undertaken without my being invited to be present. Moreover, my advice was sought as to the best method of procedure. To-day it is no uncommon occurrence for a surgeon to operate on the evidence of a roentgenogram taken for diagnostic purposes, and one which for reasons obvious to the roentgenologist is frequently misleading and inaccurate. My experiences are (owing to age and disability) confined to base hospitals in England, and the methods I employ are unsuited to hospitals at the front where cases in large numbers have to be dealt with in a minimum of time.

I rarely use fluorescent screens at the war hospitals, as the protective measures there provided are not, in my opinion, efficient. I depend almost entirely on a roentgenographic examination of the area in which the patient complains of pain or of inconvenience, and should I not find a foreign body there I rest content, for even should one be present in the tissues at

some distance from the area roentgenographed, and there are no symptoms, I think that further interference is unnecessary, not to say undesirable, for reasons I shall put before you later. At the front both the diagnosis of the presence and the

FIG. 1. PIECE OF HIGH-EXPLOSIVE SHELL IN THIGH.

One of a pair of stereoscopic pictures showing the use of metal rings to increase the stereoscopic effect. The ring *A* is placed on the side of the limb furthest from the plate. The ring *B* is resting on the plate together with the cross wires.

localization of foreign bodies has to be made by means of the fluorescent screen, and under such circumstances it is absolutely necessary that the best possible precautions be taken for protecting both the patient and assistants. It is also necessary that a powerful apparatus be used—the tubes must be of the best obtainable and the operating room made perfectly dark, otherwise (as frequently occurs), a negative diagnosis may be given when a foreign body is present. Since the commencement of the war numberless methods of localization, good, bad and indifferent, have been published, but it matters little which is chosen as long as the procedure is carried out with scientific accuracy.

For base hospital work, however, when more time can be devoted to each individual case, I prefer a method in which the personal equation plays little or no part. The method of localization I usually adopt is that of taking a pair of pictures which can be used for the double purpose of taking measurements or for use in the stereoscope. A few months back I visited quite a number of roentgen departments in the south of England, and amongst other facts which were brought to my notice, I was particularly struck with the little use made of the stereoscope, and upon inquiry I found there was a general consensus of opinion that stereoscopic pictures are misleading. With this statement I entirely disagree. If stereoscopic pictures are carefully and scientifically produced, there can be nothing misleading about them, indeed they should be of the greatest possible value both to the surgeon and roentgenologist. It is a well-known fact that many people cannot acquire the habit of seeing stereoscopically, but I find that this disability can to a great extent be overcome by rendering the roentgenograms still more stereoscopic. This, in thin parts, is easily done by increasing the distance the tube is moved between the two exposures; by rubbing on the skin subnitrate of bismuth, iodoform, or some other opaque substance; and by placing beneath and above the limb in the neighborhood of the foreign body, some easily recognized metallic rings or pointers. In the thickest parts, the rendering visible of the surface of the skin is a much more difficult task, as the amount of bismuth or iodoform which is held by the skin is not sufficient to give a clear outline. It has been suggested that the limb should be encircled with a bandage containing some opaque material held in its meshes, but the drawback to this is that no matter how carefully such a bandage is applied, disconcerting lines and marks will always appear, due to the over-

lapping of the edges of the material, and the irregular manner in which the opaque substance is distributed through it. These markings infrequently hide or blur completely the finer details of the roentgenogram. I overcome this by the use (in addition to the crossed wires) of metal rings, some of which I place under the limb or against the plate, and others on the side of the limb nearest the tube. One ring having a tail-piece I place on the side of the limb nearest the tube, so that I always know the position from which I am viewing my pictures. (See Figs. 1 and 2.)

Since adopting this method I have not found a surgeon who cannot immediately get the full stereoscopic effect, and as I always take the precaution to mark the position of the rings on the skin, in addition to those of the cross wires, the position of the foreign body in relation to these markings is easily carried in one's mind. The objection which may be raised against my method is the time occupied in bringing about the result. By adopting the following procedure, however, the time is reduced to a minimum. A mark on the upright of my tube-holder indicates the distance of the anticathode from the plate, and the Mackenzie Davidson Localizer is always kept ready fixed up at this distance, so that fresh measurements do not have to be made on each occasion the localizer is required. The tube is centred over the changing-box and marks on the floor indicate exactly where the tube-stand should be placed, so that the central rays impinge upon the exact position where the wires cross. As a matter of fact, granting that the anticathode is always fixed at a known distance from the photographic plate, a table can be constructed showing the depth of the foreign body from the surface when the shadow-shift is known. The accompanying table is constructed for a tube distance of 18″ (45 centimetres) and a tube shift of 6 cms. In all probability this table has been previously published in your JOURNAL, but I insert it here again as it may prove useful to those engaged in war roentgenol-

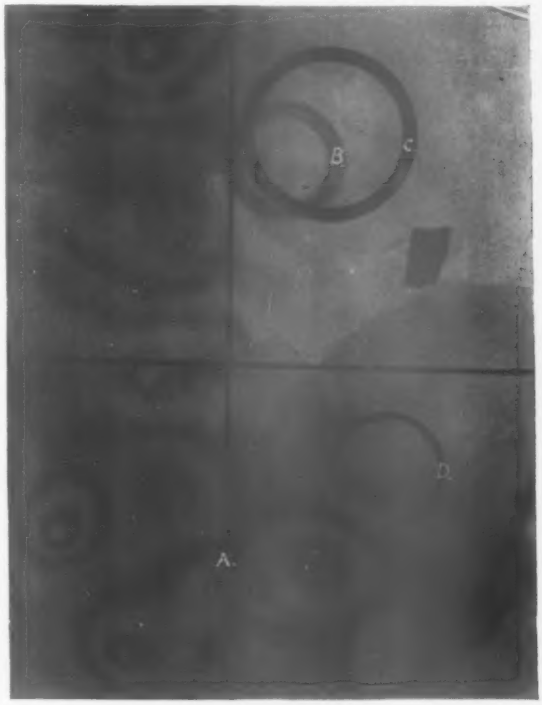

FIG. 2. PIECE OF HIGH-EXPLOSIVE SHELL IN ABDOMINAL WALL.

One of a pair of stereoscopic pictures showing the use of metal rings in increasing stereoscopic effect. Rings marked *A* and *B* were placed on the abdomen. Rings *C* and *D* were on the plate which was placed beneath the patient, on the same plane as the cross wires.

LOCALIZATION TABLE

Tube Distance—18 inches (45 cms.) Tube Shift—6 cms.

Shadow Shift in mm.	Depth of F.B. in inches	Shadow Shift in mm.	Depth of F.B. in inches	Shadow Shift in mm.	Depth of F.B. in inches
1	0.29	21	4.66	41	7.30
2	0.58	22	4.83	42	7.41
3	0.85	23	4.99	43	7.51
4	1.125	24	5.14	44	7.61
5	1.38	25	5.29	45	7.71
6	1.64	26	5.44	46	7.81
7	1.88	27	5.58	47	7.90
8	2.12	28	5.73	48	8.00
9	2.35	29	5.86	49	8.09
10	2.57	30	6.00	50	8.18
11	2.79	31	6.13	51	8.27
12	3.00	32	6.26	52	8.36
13	3.20	33	6.39	53	8.44
14	3.40	34	6.51	54	8.53
15	3.60	35	6.63	55	8.62
16	3.79	36	6.75	56	8.70
17	3.97	37	6.87	57	8.77
18	4.15	38	6.98	58	8.85
19	4.33	39	7.09	59	8.92
20	4.50	40	7.20	60	9.00

ogy. A table from any tube distance can easily be constructed on the lines of the one published here.

One of the chief difficulties which is encountered in the carrying out of this method is the fading away of the marks made upon the skin. Nitrate of silver of course produces the most lasting marks, but even these are frequently removed by the iodine which is now almost universally used for sterilising the skin. I have tried several kinds of ink, some of which have been specially recommended by roentgenologists, and find none of them entirely satisfactory. The best method of making a permanent mark over a foreign body which may have to be removed on some subsequent occasion, is to tattoo the skin with India ink.

In our hospitals at home, the wounded soldier is allowed to know the results of the roentgenographic and roentgenoscopic findings. The plates are sent to the wards with the report and they are freely discussed by the nurses and patients, so that every man knows if a foreign body is located. This knowledge has an extremely detrimental effect on the man's convalescence. Having for eighteen months filled the post of Senior Medical Officer to a Command Depot, I have had ample opportunity of observing the effects produced in wounded soldiers by the knowledge that a foreign body is present in their tissues. They complain of pain, inability to use their limbs and general discomfort, even when the foreign body is so situated that it cannot possibly afford them the slightest inconvenience, and directly their work at the Depot is increased they fall sick, seek medical advice, and demand that the foreign body shall be removed. They are willing to undergo any operation and candidly confess that they will not be contented until the foreign body has been extracted. It is useless for the surgeons to tell them that its presence cannot possibly do them any harm—the piece of metal is "on their mind" and nothing will convince them that it should be disregarded. My experience in this direction leads me to suggest that measures be adopted to prevent wounded men from knowing the results of their roentgenographic examination. Neither the report nor the roentgenogram should be accessible to them, for it is an undoubted fact, at any rate here, that ignorance spells bliss. I would go a step further, and at once abolish loose case-sheets, and under no circumstances would I permit these to be attached to boards hung on the head of the bed, as is the usual procedure. All notes on cases and reports should be entered in a book, which is accessible only to the surgeon in charge of the case and to the Sister of the ward.

In this great and terrible fight for the world's liberty, the question of manpower is all important. It is therefore imperative that no effort should be disregarded to return to the fighting line all men capable of doing their duty.

The question of secrecy as to the presence of foreign bodies has a more far-reaching effect than would at first be imagined. The young and enthusiastic surgeon is apt to believe all the exaggerated statements made by the soldier, and seeing an opportunity for exhibiting his skill, is only too willing to undertake such cases, with the result that, to say the least, the man's stay in the hospital is seriously prolonged, even if nothing worse happens. As I have before stated, my experience of the conditions at the front is limited to hearsay and reading, hence my remarks almost entirely appertain to the conditions met with in base hospitals. Foreign bodies are rarely looked for until the wounds have healed or have nearly healed. The exceptional cases being those in which the symptoms are obviously due to the presence of the foreign body, in which there is a sinus leading to the same, or in cases in which there is much suppuration. In all such cases an exact localization should be made and every possible help rendered to enable the surgeon to extract the bullet. In the majority of cases which are now being sent

home, the foreign bodies consist of small pieces of high-explosive shell. Very small pieces of this material are capable of inflicting an enormous amount of damage. I have seen the shaft of the femur broken into a dozen pieces by a small irregular piece of metal, measuring less than a quarter of an inch on its longest axis. Many of these foreign bodies held in the tissues are harmless, and did not the soldier know of their presence no symptoms would be in evidence.

Only a few days since my attention was drawn to a case in which a small nearly square piece of high-explosive shell was localized as being situated deeply in the cancellous tissue at the lower end of the femur. The symptoms complained of were entirely due to the damage done to the soft parts in the passage through of the foreign body. As this had passed through the synovial membrane there was, as it would be expected, a limited amount of synovitis. There was no evidence of any suppuration and I see no reason why the symptoms should not subside after a few weeks' rest, and there should be no reason why this foreign body should be removed. Now this soldier will, in all probability, be made aware of its presence, with the result that pseudo-symptoms are likely to arise and some enthusiastic young surgeon may be persuaded to remove it. In all operations for the removal of foreign bodies certain risks must be run, and it is of paramount importance that these should be taken into consideration. No operation, however small, can be performed without leaving behind some slight disability, and cannot be undertaken without risk. I know it will be argued that the risk is so small as to be negligible, but the fact remains that there is a risk.

Let us for a moment consider the risks of the removal of a foreign body situated deeply in the tissues and which, if left alone, would prove harmless. They are as follows:

1. The administration of an anesthetic.
2. The possibility of suppuration.
3. The remote possibility of death from shock.
4. The possibility that the foreign body may be missed, no matter how accurately it may have been localized.
5. Disability caused by the severance of nerves and by the scar.
6. The length of time during which the soldier occupies a bed unnecessarily.
7. The fact that having undergone any operation the mental condition of the man may be rendered worse rather than improved.

The question as to when a foreign body should be removed and when it should not, may to some extent be debatable, but there exist certain obvious rules which should be followed as a matter of routine.

A jagged piece of shell embedded in a muscle which is in constant use is a source of danger.

A piece of shell or bullet in such a position as to impede movement.

A piece of shell or bullet in the hands or feet in such a position as to be irritated by pressure and detract from the usefulness of the limb.

I am informed by a surgeon who has had considerable experience in base hospital work, that out of the thousands of cases that have come under his notice, in only one instance has a foreign body which had been left in the tissues caused trouble. This was in the case of a man who returned from the front with a swelling in his thigh and running a temperature. The swelling was found to be an abscess which had to be drained, and in the centre of which was found, not only a piece of shell, but what was more important, and which had not been diagnosed, a fragment of the man's tunic. In this case it is curious to note that no ill effects were experienced until the man had been on active service at the front for some months. In my twenty years experience as a roentgenologist, I have met with many cases in which bullets embedded in the tissues have produced far less disablement than would an operation for their removal.

Case 1. A man during the South African War had a shrapnel bullet pass through his chest wall and it was localized as being embedded in the lower lobe of his right lung. I have not seen or heard of the man for five years, but up to that time he was in the best of health and suffered from no disability.

Case 2. An officer consulted me who had a Mauser bullet apparently contained within the synovial membrane of his left knee. I strongly advised its removal, but he absolutely refused to undergo any operation. Five years afterwards he informed me that it had not troubled him in the slightest degree, and apart from the fact that he knew of its presence, it had caused him no disability.

Case 3. A well-known public man in this country was shot by a tramp, the bullet lodging somewhere in his neck. Seven years afterwards he consulted me owing to his having spat up some blood-stained mucus. The bullet was located embedded in the base of the skull. An examination of the patient's throat proved that hemorrhage was not caused by its presence. It is now seven years since he consulted me, and I believe I am right in stating that the bullet has caused him no disability.

These cases, together with many others which I have known, convince me that a major operation for the removal of a foreign body which is not causing obvious symptoms is, to say the least, undesirable. Having tasted the horrors of modern warfare, there are a large number of men who have returned home (some only slightly wounded), who are not at all anxious to return to the trenches. Some of these are prepared to undergo any operation to secure a longer stay at home. They are apt, under these circumstances, to exaggerate their symptoms and to bring pressure upon the surgeon to perform an operation. In the hurried roentgenoscopic examination made at the front, many foreign bodies are overlooked, and many injuries escape diagnosis. It is therefore necessary that these cases should be roentgenographed and a more complete examination made. A roentgenographic department is at the present time an expensive necessity, and it is therefore necessary (in order to prevent undue wastage) that the reports should be full and conclusive. The army form used for such reports in this country is divided into two parts—the first for a brief history of the case, which is supposed to be filled in by the surgeon-in-charge, and the second for the roentgenologist to record his findings and remarks. In my experience the first half rarely gives any indication of the true state of affairs, the usual remarks herein made being—1. For foreign body. 2. For injury to bone or fracture.—No indication is given as to the position of the wound or the existence of an exit wound. These facts have to be elicited from the soldier himself unless the dressings be removed and a careful examination be made by the roentgenologist.

Roentgenologists should insist that this brief history of the case be supplied in sufficient detail to enable them to get a grasp of the case and to carry out their work efficiently. They cannot be expected to obtain all these details themselves. The surgeon's notes should always be sent to the *x*-ray department with the case, and, whenever possible, splints and dressings should be removed, as it not infrequently happens that these render some of the finer details of the roentgenogram difficult to decipher.

Reduced pictures (however good they may be) are not in my opinion to be compared with full-sized ones. Especially is this the case in roentgenograms of comminuted fractures of the long bones where numerous fragments are present. In these cases stereoscopic pictures are a great help and personally I prefer them to any others. Many surgeons, however, prefer to have anteroposterior and lateral views, and it is a moot point as to which, under all circumstances, convey the greater amount of knowledge.

The free use of bismuth and iodoform paste (Bipp) in France, is a source of

much annoyance to the roentgenologist at home. The paste not infrequently obscures the part which it is most urgently necessary to see; and where the presence of a foreign body is suspected, it must occasionally render the task of showing it absolutely hopeless. Small masses of the paste are sometimes mistaken for fragments of shell, and instances have occurred where an operation has been undertaken for their removal. Experience on the part of the roentgenologist will enable him to decide which is which. The general outline of the masses and the absence of sharp projections act as a guide. From the roentgenologist's point of view it will be a happy day when Bipp is replaced by some other compound which is not so obstructive to the passage of the rays.

The double-coated *x*-ray films made by the Austin-Edwards Dry Plate Co. are exceedingly useful under some circumstances, owing to the fact that they can be bent without injury. They can frequently be used when a plate cannot;—for instance, they can be slipped in between a bent joint and an angular splint, and a patient with a painful wound in the back can lie on one placed between the flesh and a folded blanket without discomfort, when it would be impossible for him to rest for a moment on a plate supported by a hard board.

I would like to lay stress upon the importance of always roentgenographing injuries to the long bones, where any injury is suspected, from more than one position, as it not infrequently happens that extensive injury may be done to the surface of one of these bones without any indication being seen in the a.p. view, whilst the injury stands out conspicuously in a lateral view, and vice versa. This injunction particularly applies to injuries about the ankle-joint and knee. In fractures of the lower third of the tibia, the upper portion of the fibula should always be included in the roentgenogram; and in all fractures anywhere near the joint, the joint itself should be included.

All roentgenograms should be numbered at the time they are taken. This is easily done by numbering instruments now procurable from dealers in *x*-ray apparatus, but inasmuch as these are unsightly and occupy a large space on the picture, I prefer to fashion little figures out of wire and stick these on a piece of adhesive plaster, which is laid on the plate at the time the exposure is made. The carrying out of this procedure involves only a small expenditure of time and prevents all possibility of mistake.

In conclusion I beg to thank you, Mr. Editor, for kindly publishing these notes and trust that some of the suggestions made herein may be of use to my American friends.

AN INSTRUMENT FOR RAPID FLUOROSCOPIC FOREIGN-BODY LOCALIZATION BY COMBINED PARALLAX AND DOUBLE RING METHODS *

BY EDWARD S. BLAINE, M.D.

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NEW YORK

IN THIS presentation the author expressly disavows any claim to the discovery of a new method of projectile localization. Historically it is a fact that the parallax method was one of the very first to be proposed after the discovery of the *x*-ray in 1895, and the double ring followed shortly after, as will be verified by a visit to the archives of roentgenology. Notwithstanding this, the parallax method has been "discovered" many times over. Levy-Dorn in 1896 made use of the parallax principle in the determination of the depth of a projectile by the simple maneuver of introducing his hand under the vertical fluoroscopic screen and moving a finger forward and backward until it was at the same distance from the screen as the foreign body. This, of course, was before the danger of such a proceeding was known and is absolutely not to be considered at this day. The earliest use of the double-ring principle appears to have been made by Redner, who fastened small pieces of metal on the skin at the points of inlet and outlet of the *x*-ray beam as it passed through the projectile. Rosenthal devised a handle with a ring which had an inker in its center while Angerer used a similar device, two such rings, however, being used. Exner combined the double-ring method with the triangulation method and later used the parallax in place of triangulation. From the foregoing it will be seen that nothing new has been "discovered" in this article.

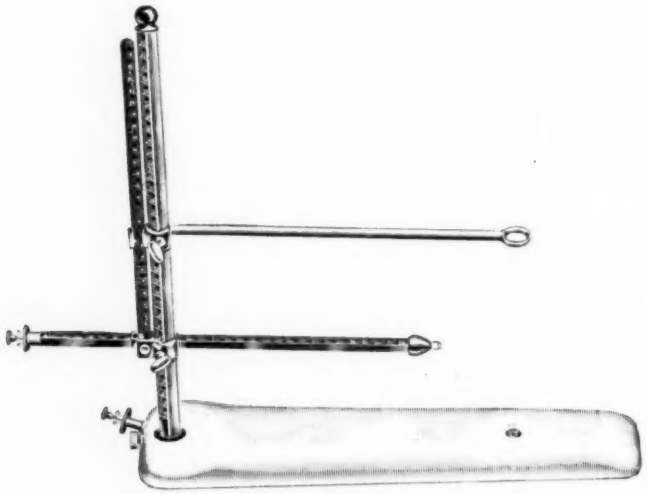

FIG. 1. INSTRUMENT FOR USE WITH THE PARALLAX AND RING METHOD.

The instrument herein described is illustrated in Fig. 1. It provides an easy,

* Original model presented at the Midwinter Meeting of American Roentgen Ray Society at Atlantic City, N. J., January 6, 1918.

convenient and rapid means of roentgenoscopic localization and enables the roentgenologist to not only obtain the depth from the skin above the projectile, but also the distance from the skin below the projectile, and, further, the distance to the foreign body from the skin on the side of the part at the level of the foreign body. Thus it could be termed a "triple localizer," giving, as it does, three depths at one setting of the instrument.

The Parallax Principle.—This is illustrated in Fig. 2, which shows that the shadow projections of objects in line, but at different distances from a source of light, will be superimposed on a plane surface, but will, on displacing the light, move in an opposite direction at different speeds and distances according to their relative positions. The shadow of the one farthest from the surface will travel the greater distance. If, now, this object be raised, its shadow will approach that of the one nearer the surface, and when both are on the same level, their shadows will be equidistant from the original point from which they started. This gives but one dimension, that of depth.

The Double-Ring Principle.—This is shown in Fig. 3, in which it will be seen that when two rings of same diameter are brought in line with the central beam of a light, their shadows will be superimposed upon a plane surface in a concentric manner, that of the one farthest from the surface being the larger and surrounding the shadow of the ring nearest the surface. Now if one of the rings be placed over and the other under an object, a line drawn through the centers of all three will be a straight line. This establishes only the line upon which the object lies.

The Combination.—It will be seen by the preceding paragraphs that each of the two methods described lacks what the other provides in the accurate localization of a projectile. Both are necessary to the surgeon: thus the parallax gives no information as to the line upon which the foreign body lies, though it gives the depth, while the double ring establishes the desired line but does not give the depth. Combining the two into one has proved to be a happy solution of the problem, and this instrument provides a means for applying

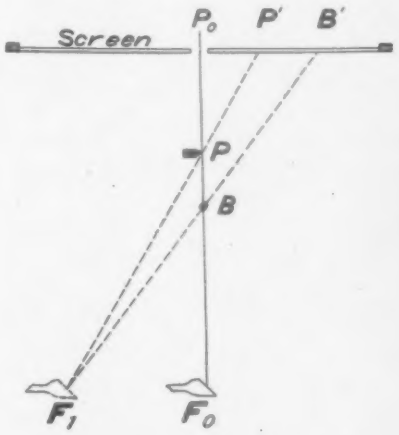

FIG. 2. PRINCIPLE OF THE PARALLAX METHOD.

Auxiliary body, *B*, below *P* and distal from the screen shows greater shadow displacement to *B'*.

these desirable features. In the schematic drawing, Fig. 3, is indicated the manner in which this is accomplished. Here the upper ring, *R*, and the lower ring, *C*, are in vertical line with the projectile, *P*, and the parallax rod, *B*, is on a level with it.

The Instrument.—This consists of an aluminun base at one end of which is mounted an upright post which carries two horizontal arms. The upper arm has a ring at its free end and is adjustable in vertical direction only. The ring center is at a fixed distance from the upright post. The second arm is the parallax rod which is adjustable in two directions, vertical and horizontal. A ball or cone is attached to the end of this rod. In the center of this ball is a wick that can be extended when pressure is made on the plunger at the opposite end. In the base of the instrument is mounted a ring of the same size as the upper one, but with a finger containing a wick which can be pushed into the center of the ring. These wicks are to be inked with suitable skin ink for the purpose

of marking the skin. To the right of the upright post is placed a vertical scale which is graduated to quarter-centimeters; this scale indicates the distance from the under side of the upper ring (the skin) to the

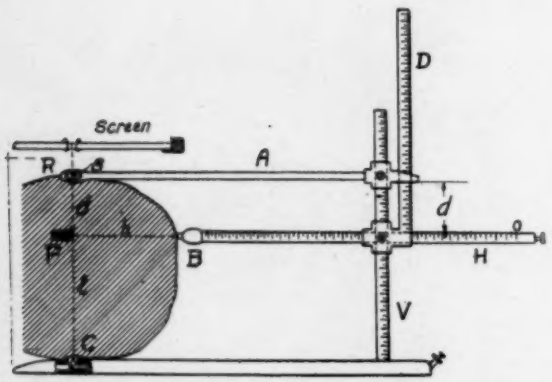

FIG. 3. SCHEMATIC DRAWING OF THE BLAINE MODEL PARALLAX LOCALIZER.

center of the ball on the parallax rod (level of the projectile), thus giving the depth, *d*, from above. The upright post is similarly graduated and gives the distance from the upper side of the lower ring (the skin underneath) to the center of the parallax ball, thus giving the depth, *l* (height from below). A third scale is provided on the parallax rod which also is graduated in quarter-centimeters, this reading giving the lateral distance from the tip of the parallel rod ball (skin mark), thus giving the depth, *h* (lateral), from the side at the level of the projectile.

All three scales are direct-reading and no addition, subtraction or other mathematical proceeding is required in this triple localization.

To facilitate the proper and accurate judgment of the shadow displacements of projectile and parallax ball, an accessory guide is found in a rectangular transparent celluloid sheet upon which have been drawn several parallel lines (Fig. 4). This is laid upon the surface of the roentgenoscopic screen and, being transparent, the shadows are clearly seen through the celluloid. This enables the roentgenologist to shift the projectile shadow from one of the parallel lines to another and then to raise or lower the parallax ball until the center of its shadow on the screen will coincide with the same transverse line on the celluloid sheet as that to which the projectile shadow was moved.

Modus Operandi.—The instrument must be placed on a plane surface which is parallel to the tube travel. If the table is level, the top will, most likely, be the same. The focal spot of the tube must be in the exact center of the diaphragm shutter. Incidently the double ring is a most accurate means of establishing this point. Thus, if the focal spot be in the true center of the diaphragm, the shadows of the two rings will be concentric on the screen, whereas, if it is not so situated, they will overlap. Should this be the case, it will be necessary to move the *x*-ray tube in its holder until the proper position is obtained. A sagging table top will interfere with the proper working of the instrument. With the U. S. Army portable *x*-ray table, the stretcher-type top necessitates the use of a filler board to provide the plane surface required to set the base of the instrument upon. A small pocket level will materially assist in ascertaining the proper setting of the surface to be used. This may be a wooden board ½ to ⅝ of an inch thick and about 12 x 18 inches in size. For the comfort of the patient, blankets may be doubled to the thickness of the board and placed to right and left of the board. Having determined that the instrument has the proper surface and focal-spot setting, it is removed and the wicks replenished with fresh skin ink such as the Finzi formula. The patient is brought on the table and a preliminary *x*-ray examination is made of the entire body to discover in what regions the projectiles or fragments lie which are to be localized.

Selecting one of these, the tube is brought directly under the projectile and centered with the smallest diaphragm opening and the *x*-ray turned off. The upper arm of the instrument is raised to a

point higher than the thickness of the part to be examined and the parallax rod is drawn backward far enough so that the ball will not touch the patient's skin. The base of the instrument is now slipped under the part, the ring to set as near as possible to the estimated position of the object. Under the *x*-ray light the instrument is adjusted so that the two ring shadows surround the projectile shadow. The arms of the instrument should be as near at right angles to the long axis of the part as possible. Place the celluloid with parallel lines on the screen surface with one of the lines directly in the center of the rings and projectile and exactly in line with the arms of the instrument. If the projectile be at some distance from the edge of the part, the screen may be moved so that the projectile shadow is set at the far side of the screen, taking care that one of the parallel lines sets in line with the arms of the instrument as previously noted. The diaphragm shutter is now opened and the tube is displaced to right or left an amount sufficient to move the projectile shadow to the next parallel line. Lock the tube against longitudinal travel and bring the focal spot under the edge of the patient. Bring the parallax ball cautiously toward the skin but do not allow it to touch the skin. The shadow of the ball will be seen to be nearer to or farther from the starting line according to its relation, in level, to the projectile. The parallax rod is now raised or lowered until the center of its shadow is in the center of the same parallel line on which the projectile shadow lies. The *x*-ray light may now be discontinued. Move the parallax rod forward until it touches the skin, lock the two set screws and press the plunger to mark the spot on the skin. Press the plunger on the base to mark the skin underneath the projectile. Lower the upper ring until it touches the skin and mark the center of the ring with suitable skin ink. The instrument may now be removed and the depths on the three scales read and noted. The screen may be at any convenient distance from the skin; no deductions are necessary for screen to skin distance at any position.

The actual time that the *x*-ray is in operation is but a few seconds and with a little practice the entire localization can

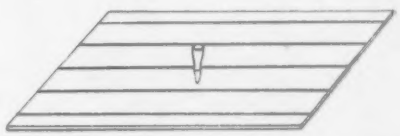

FIG. 4. RULED CELLULOID SHEET TO GAUGE THE SHADOW DISPLACEMENTS OF PROJECTILE AND PARALLAX BALL.

be performed in approximately 1 minute. The degree of accuracy obtained leaves but little to be desired. Few errors of more than 2 to 4 millimeters occur when one has accustomed himself to the instrument. Major James T. Case, Director of Roentgenology of the American Expeditionary Forces, states that, as a rule, localizations within ½ centimeter are entirely satisfactory in practical roentgenosurgical work.

From the surgical point of view this instrument gives more information than the usual simple depth methods and permits the surgeon to choose between three points of attack for the removal of a given projectile. If the anatomy be such that it would be inadvisable from an operative standpoint to go in by way of the upper skin mark, the patient may be turned over and the rear skin point used; or, in other cases, the side may be the best from which to approach the foreign body.

The original model of this instrument had an inker in the center of the upper ring and all skin marks were made simultaneously by pressure of a single plunger to which were attached flexible cables to each wick. This was modified to conform to the requirements of the work in the medical department of the U. S. Army, which has adopted it as one of the standard localization instruments.

In such cases as it is inadvisable to use the instrument as above described—which

necessitates the insertion of the aluminum base *under* the patient—the simple parallax principle may be used by releasing a small set screw in the base and turning the upright post with its upper ring and parallax rod, 90 degrees to the right. The base may now be set alongside of the patient and the depth of the projectile under the upper ring may be found in a similar manner as previously noted. If the instrument is level, the lateral distance may also be obtained, giving two dimensions at right angles to each other.

An additional use to which this instrument may be put is in marking the upper and lower skin points for the several pairs of spots required in such a method as the profundometer described by Flint in a recent publication, in which the several pairs are connected with straight lines. Their crossing indicates the location of the projectile.

TREATMENT OF MYELOCYTIC LEUKEMIA BY RADIUM

Thirty consecutive cases of myelocytic leukemia were treated at the Mayo Clinic by means of the surface application of radium element over the enlarged spleen. A certain degree of general improvement, together with reduction of the size of the spleen and of the leukocytic count, occurred in every instance, even in the most advanced and toxic cases. Marked temporary improvement occurred in twenty-six patients, and a remarkable improvement in thirteen. Hemorrhage ceased as a rule after one or two series of exposures. In two instances, hemorrhage occurred after radium exposures when it had not occurred previous to treatment. In these instances the hemorrhage seemed to be the result of overexposure; an anemia also developed; both the hemorrhage and the anemia were successfully combated by means of transfusion. In twenty-five patients there was definite improvement of the anemia concomitant with the improvement of the general condition. The reduction of the number of leukocytes was due chiefly to not only an absolute but also a striking relative fall in the myelocytes; there was a striking fall in the absolute count of polynuclears, while their relative percentage remained approximately the same. There was also a marked fall in the absolute count of small lymphocytes. Surface exposures of radium over the spleen of myelocytic leukemia usually effect a very rapid reduction of the size of the spleen, a fall of the leukocyte count, improvement in the general condition and together with transfusion, constitute at present the most effective temporary measure in the treatment of the disease. (*Boston M. & S. J.*, Nov. 15, CLXXVII, No. 20.) (Ref. *Jour. M. Assn.*, Dec. 15, 1917, p. 2069.)

THE APPENDIX WITH ESPECIAL REFERENCE TO PERISTALSIS *

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IT IS the purpose of the writer to pursue an outline of the subject which will have a bearing on the various phases directly affecting the science of roentgenology.

Acute appendicitis does not offer a very fruitful field for roentgen diagnosis, because the usual clinical methods suffice for proper recognition. Occasionally one might be enlightened in a left-sided appendicitis, in which case a careful fluoroscopic examination during the administration of an opaque enema would reveal a case of transposition.

The vagaries of chronic appendiceal involvement often render the diagnosis difficult. Atypical symptoms in some cases lead to a faulty diagnosis and, after removal, the appendix is found to be uninvolved and the condition of the patient remains as heretofore. The appendix has frequently been removed when the real cause of trouble was a stone in the urinary tract (especially in the lower right ureter), tuberculous peritonitis, tubercular mesenteric glands, painful right inguinal hernia, pleurisy, etc. This is a sin of commission because of the attendant operative risks, also, because an organ has been removed which probably has a function. Conversely, if a chronic appendiceal condition exists and its existence is not recognized, we not only allow the retention of an inflammatory organ but permit the development of functional and organic derangements, first in the appendix itself; second, on neighboring and associated organs. It is widely recognized that when a patient has once had an attack of appendicitis there is liability of recurrence unless the appendix has been removed. It is therefore evident that any method which can supplement clinical methods in attaining a correct diagnosis should be welcomed.

The roentgenological examination offers such tangible help and is disassociated from any risk or hazard to the patient.

Albers-Schoenberg, Holzknecht, Hurst, Béclère, Jordon, Groedel, Riedel and other European roentgenologists did some early work on this subject; however, considerable credit must be given some of our American collaborators, notably Cole, Case, Quimby and George, for early appreciating the possibilities of this method of examination.

According to the classification of Treves there are four principal types of cecum and the origin of the appendix varies with the type of cecum present. The movable portion of the appendix may be met with in different situations. It may pass upward and in front of the cecum and colon; upward and behind the cecum, and even behind the colon between the two layers of the mesocolon; upward and to the inner side or upward and to the outer side of the cecum and colon. It may pass to the left under the ileum and mesentery; upward and to the left or downward and to the left into the true pelvis. It may pass directly downward under the cecum. It may pass to the right in front of or back of the cecum. It may occupy any of the pericecal fossæ, but more often enters the ileocecal fossa. When the cecum is mobile the appendix may be found almost anywhere within the abdomen. When the cecum is undescended, the appendix shares in the failure to descend and may be below the gall-bladder or in front of the right kidney and may pass in several directions; upward behind the cecum, to the left behind the ileum and mesentery, or down-

* Read before the Chicago Roentgenological Society, April 19, 1918.

ward and inward into the true pelvis. McBurney's point is an accepted empirical localization based on the law of average. The roentgen examination following the administration or injection of an opaque media will many times visualize the ap-

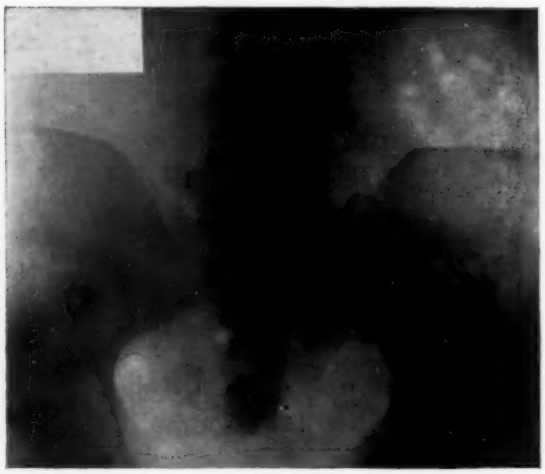

FIG. 1. INTERESTING BECAUSE SEGMENTED. SUGGESTS APPENDICULAR PERISTALSIS.

pendix and always will visualize the cecum. In this way the location of the appendix can be quite accurately determined.

Physiologically considered the appendix is thought by some to be a vestigial structure. It has been suggested that the vermiform process in man is the degenerated remains of the herbivorous cecum, which has been replaced by the carnivorous form. The appendix is found only in man, the higher apes and the wombat, although in certain rodents a somewhat similar arrangement exists. In carnivorous animals the cecum is very slightly developed; in herbivorous it is usually large.

Robinson has deduced from a series of experiments that to suppose that the appendix is a degenerative, useless organ is gratuitous. He concluded that the acid liquid secreted by the appendix plays the part principally of a hormone, stimulating the cecum to provoke its contractions and expedite the issue of the feces collected.

"The observations of physicians show that constipation and cecal stasis are early and permanent in patients attacked by appendicitis."

The appendix is an independent organ and a useful one, the physiological function of which becomes more and more evident. Its ablation in numerous doubtful cases is a harmful act, since the large intestine suffers and the patient suffers a loss in the physiological function of defecation.

Berry and Lack are quoted as follows:

1. Lymphoid tissue is the characteristic feature of the true cecal apex throughout the animal kingdom including man. As the vertebrate scale is ascended it tends to be collected together into a specially differentiated portion of the intestinal canal—the vermiform appendix.

2. The amount of lymphoid tissue present at the cecal apex varies, most probably, though not certainly, in accordance with the varying diet of the animal.

3. The vermiform appendix of man is not, therefore, either a vestigial remnant or an organ in a state of retrogression; but is an actively functioning lymph gland. It is no argument against this view to state that because the appendix is frequently removed without any apparent functional disturbance that it is useless, because the same argument might be adduced against the stomach, which is occasionally removed

FIG. 2. LONG APPENDIX WITH SEGMENTATION SUGGESTIVE OF APPENDICULAR PERISTALSIS.

either wholly or in part and with more or less success.

4. The appendix of man is not equally functional throughout the whole of life, at birth it contains practically no lymphoid tissue; within six weeks it has become a lymph gland and continues as such during the first half of life, after which it progressively declines in functional activity. Lymphoid tissue is, therefore, a tissue of the growing animal.

5. Obliteration of the vermiform appendix is a pathological process.

6. The functions of the human appendix are the same as any other collection of lymphoid tissue in any other part of the body.

Morgera states that the digitiform gland in *Scyllæa* is the homologue of the vermiform appendix in mammals. The glandular epithelium of the digitiform appendix shows a strong secretory power which has a strong effect on the emulsification of fats. The removal of this gland or the closure of the intestinal duct from it, in experimental animals, shows that the feces are not evacuated with their usual regularity. Extracts of this secretion injected into the lower intestinal tract have accelerated intestinal peristalsis or accentuated expression of feces. He writes a further report and says he is satisfied that the ectoproctic power of the vermiform appendix in man and mammals is identical with the above.

FIG. 3. AT TIME OF EXAMINATION APPENDIX APPEARED NEGATIVE.

Mention was made of potential danger. Shortly afterward an acute appendicitis developed.

Heile made a series of animal experiments to determine the physiology of the appendix. From these he draws the following conclusions: "The appendix contains in its walls ferments which can be demonstrated in the lumen of the living appendix as secretions of that organ. These ferments are endocellular in nature and can be separated from their cell connection by autolysis. There are hormones present in the cells of the appendiceal lining, capable of initiating powerful contractions of the bowel in the living animal. Therefore the function of the appendix is analogous to that of the appendix of man."

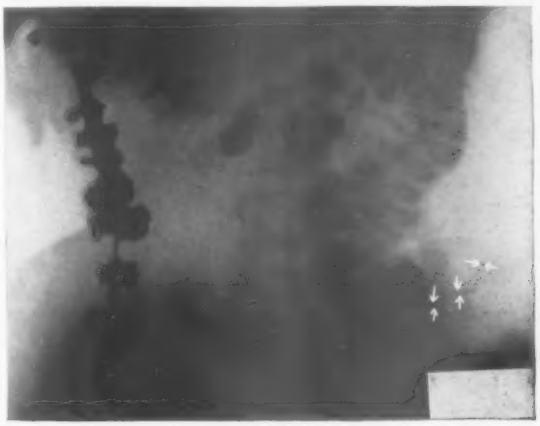

FIG. 4. APPENDIX LOCATED EXTERNAL TO CECUM.

Cecum and ascending colon pushed mesially by abscess which contains the appendix. Marked spasticity of descending colon.

Waller states that clinical observations become more and more convincingly certain that the appendix possesses a peculiar neuromechanism which normally is exercised in the designed functional activities of the ileocolic region.

Keith's recent "New Theory of the Causation of Enterostasis" and the theory of "Sphincteric Zones" as the pacemakers of intestinal peristaltic activities, consider a ceco-appendiceal plexus zone. It is con-

sidered that normally there is an intimate coördination in the rhythm of each successive segment of the entire intestinal tract, and that any disturbance, irritative or inflammatory, upsets this rhythm with reflex manifestations in the form of

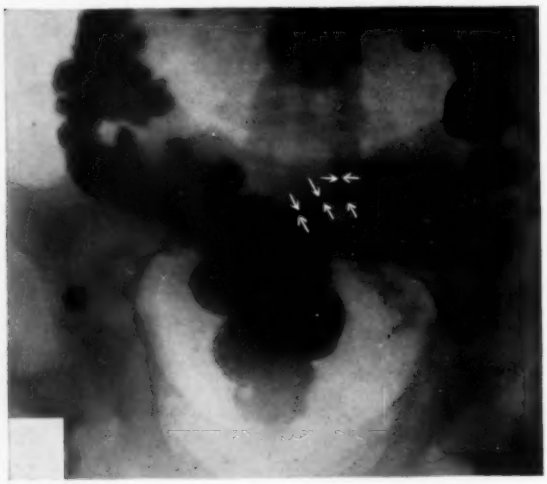

FIG. 5. APPENDIX LIES LEFT OF THE MEDIAN LINE.
An associated symptom was bladder irritability. Cecum lies in bladder region.

spasms. Thus given an irritative lesion in the appendix, reflex spasm occurs, and if permitted to continue over an extended period, there is a progressive weakening or atony of the circular muscle fibres which provokes an enterostasis. Such a view has recently been put forward by Ochsner.

Cohn contends that antiperistalsis of the colon plays an important part in the filling of the appendix. The appendix empties by its own proper movements. Evacuation may be hindered; then there is stasis. The appendix is seen full when the larger intestine is empty for some time. While the colon is filling, the appendix fills and empties several times. In alternately filling and emptying, the appendix describes movements and takes forms which vary much. Its variations of forms have often been considered as twists at the time of operation or as pathologic alterations.

Siccordi states that in young rabbits it can easily be demonstrated that there are more or less regular contractions of the organ *in situ* and such can be registered graphically. These are ample and frequent rhythmic movements at certain temperatures of the solution. Such movements under favorable conditions persist for seven and eight hours after excision of the appendix and clearly demonstrate the peristaltic characteristics of the movements.

In man it is more difficult to demonstrate mobility of the organ *in situ*. In adults, in healthy appendices excised from individuals between the ages of eighteen and thirty-four years (as the graphs presented by Siccordi demonstrate), rhythmic movements take place in special Ringer's solution; very slow, slight, but sufficiently regular and with modifications according to the temperature. He says that the oscillations and variations of the appendix musculature can be made manifest by administration of barium and the *x*-rays.

Waller recites the observations of one case, after administration of opaque meal and fluoroscopic examination:

"The appendix is alternately of greater and lesser density in various areas (suggesting segmentation) and at certain periods of the examination the apex is well

FIG. 6. CECUM ONLY PARTIALLY DESCENDED. APPENDIX LIES ON ILIAC CREST.
Anomalous development present; the pelvic colon runs horizontally to the right with angulation in region of appendix. What might appear as the transverse colon is the pelvic colon.

FIG. 7. APPENDIX LYING ON PELVIC BRIM WITH FIXATION OF TIP.

filled. At times there appears to be motion in this organ, but I am not absolutely certain that this is independent of the peristalsis of the adjacent viscera. After manipulation of the cecum (at which time the appendix is well filled) the tendency to evacuation of the appendix is evident."

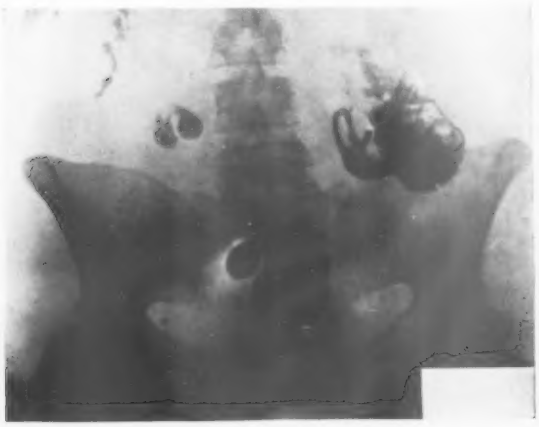

FIG. 8. THE CONFORMATION OF THIS APPENDIX WAS VIRTUALLY THE SAME IN BOTH LYING AND STANDING POSTURES. THIS WAS DUE TO EXTENSIVE ADHESIONS.

FIG. 9. SHORT CECUM AND ASCENDING COLON.
Riedel's lobe of liver present with low hepatic flexure. Appendix adherent. Case of Situs Inversus.

The writer has had the same experience in several cases in which segmentation was present, leading him to conclude that peristalsis in the appendix did exist.

There are two methods of visualizing the appendix: One is by injecting an opaque

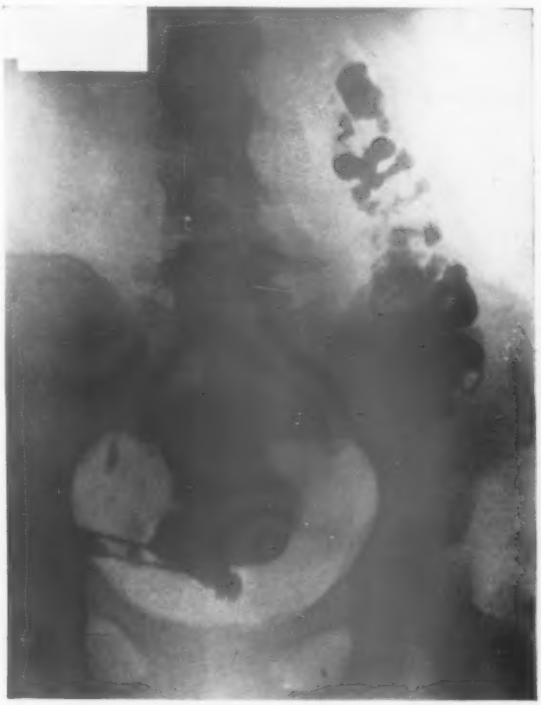

FIG. 10. APPENDIX CURLED AND ADHERENT. CECAL STASIS MARKED.

enema; the other is by the ingestion of an opaque meal. The second is preferable because of the greater frequency with which the appendix can be demonstrated. This would demonstrate that antiperistalsis in the cecum and ascending colon were the

FIG. 11. APPENDIX RUNS UP AND TO THE LEFT TOWARDS GALL-BLADDER REGION.

Previous diagnosis gall-stones. Fixation of appendix produced angulation of ascending colon.

prime factors in filling the appendix, rather than gravitation. In examining the patient the fluoroscopic method is the most satisfactory. This should be done in the vertical and horizontal positions. Occasionally the Trendelenburg position is necessary to release a pelvic cecum which might be incarcerated or possibly adherent.

By proper manipulation an otherwise hidden appendix can be shown; also its movability and relationship to the surrounding structures can be noted. The plate method should also be used, for it occasionally gives additional information. Sometimes stereoscopic plates are indicated whereby one can trace a retrocecal appendix or an appendix in close proximity to the cecum or ileum.

It is necessary that the lumen of the appendix be patent. The appendix may not be demonstrated if its lumen is obliterated or if adhesions or kinks are present near the proximal end; or if an acute attack exists, the infiltrated mucous membrane prevents the entrance of the opaque substance. Also an enterolith, or previously contained food matter, may prevent its filling.

The writer has had several cases in which the first examination failed to reveal the appendix, but a second examination disclosed its presence.

The time of examination is important, for the appendix commences to fill shortly after the cecum. This is usually after the sixth hour, although there are cases that fill earlier. From this time until the bowel is empty and often for several days afterwards, the appendix remains visible. Pirie has reported one case in which the shadow persisted for forty-three days.

Pathologic evidences of previous appendiceal inflammations are: Peritoneal adhesions; obliterations of the whole or portions of its lumen; strictures of the lumen with more or less dilatation distal to it; and, lastly, the presence of hard concretions which are retained by strictures or produce the same effects as strictures.

Concretions can occasionally be shown. The other factors are inferential from the following information. The visualized appendix with fluoroscopic manipulation will give us: (1) The size, including length and caliber; (2) position and direction; (3) drainage; (4) mobility; (5) kinks; (6) the location of applied pressure to visceral

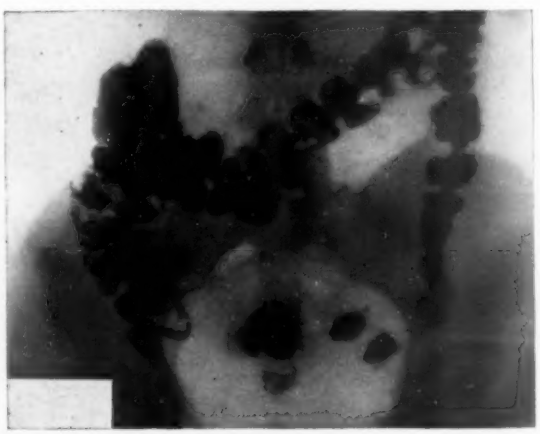

FIG. 12. APPENDIX CURLED UPON ITSELF WITH TIP SELF-ADHERENT. SPASTIC COLON.

topography. This latter point is quite important, for should pain be constantly elicited by pressing on the appendiceal shadow, one should suspect its involvement, for seeing palpation is more valuable than palpation without seeing.

This often throws light on cases in which anomalous symptoms have resulted from the appendix being located in the pelvis, behind the cecum, or unusually high, when the symptoms may simulate gall-stones or duodenal ulcer.

The fluoroscopic examination will often reveal the presence of adhesions in connection with the appendix, terminal ileum and cecum, whether to each other or the surrounding parts.

If the cecum is in the pelvis it can often be drawn into the right iliac fossa; if not, it may be necessary to resort to the Trendelenburg position.

The appendix produces effects on remote organs. The stomach may be hypertonic so that it empties itself rapidly, which phenomenon is more frequently associated with duodenal ulcer. More commonly a spasm occurs in the center of the stomach. Indeed, chronic appendicitis is, after gastric ulcer, the most frequent cause of spasmodic hourglass constriction of the stomach. Sometimes pressure over the appendix will produce a spasm; in many cases epigastric discomfort was simultaneously produced. Barclay states that appendicitis causes an impairment of the ileopyloric reflex producing dyspepsia. Occasionally we have associated a delayed pylorospasm. Intestinal stasis sometimes results from adhesions following a chronically inflamed appendix.

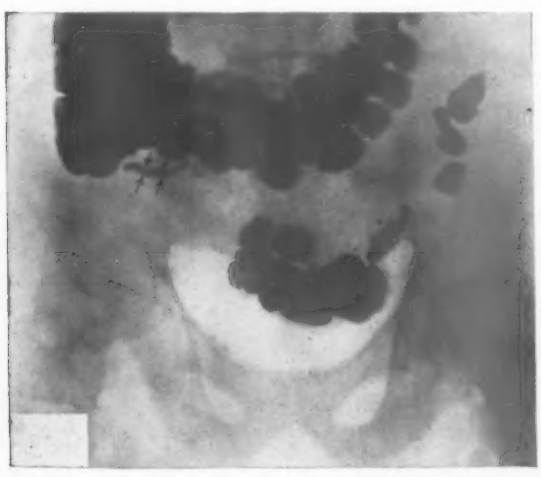

FIG. 13. LACK OF DESCENT OF ASCENDING COLON AND CECUM WITH CORRESPONDINGLY HIGH APPENDIX, ADHERENT NEAR RIGHT URETER.

FIG. 14. APPENDIX EXTERNAL TO CECUM. CECUM IN TRUE PELVIS AND ADHERENT.

Cecal and colonic stasis are often due to reflex inhibition resulting from chronic appendicitis. In such cases the cecum and ascending colon are unusually large. Enterospasm usually affecting the proximal half of the transverse colon is sometimes present. When the appendix is situated in the pelvis, dyschezia may be produced.

Conclusions.—1. Because the appendix may have a physiological function it should be studied roentgenologically before removal in chronic cases.

2. Because it possesses peristalsis, the roentgen demonstration of appendiceal retention or rapid expulsion of barium is of diagnostic value.

3. Because of its reflex influence over the

FIG. 15. APPENDIX CURLED WITH TIP ADHERENT TO CECUM.

FIG. 16. SIX-HOUR P. C. EXAMINATION MARKED ILEAL STASIS WITH DISTENTION OF SMALL BOWEL: Due to appendiceal involvement.

alimentary tract, the appendix should be investigated by the barium method in many diseases of the stomach and intestines.

4. Because of its anatomical relation to the cecum, the location of the appendix can be determined approximately even when not visible on plate or screen.

5. When barium-filled, the appendix can be studied by the screen in great detail and accurately palpated for pressure-pain and adhesions.

ROENTGEN RAY AND ANTIBODY PRODUCTION

To test the effect of the ray on antibody production after it is well under way, that is, a few days after the introduction of the antigen, it proved advisable to use animals that would stand repeated bleedings better than the rat. The purpose now is to present briefly the results of experiments of this and like nature made by Hektoen on the dog and the rabbit. He found that exposure of dogs and rabbits to the roentgen ray at about the same time as antigen is introduced may restrain in high degree, and under some conditions completely, the production of antibodies as measured by the antibody content of the serum. The results correspond fully to those previously obtained from experiments on the white rat. When antibody production is at or near its height, exposure to the roentgen ray appears to have but little if any effect on the antibodies in the blood, and at this time dogs appear to have an increased resistance to the effects of the ray just as rabbits in the period of active production of antibodies have an increased resistance to effects of benzene. Whether there is any relationship between this apparent resistance to the effects of roentgen rays and the reported beneficial effect of the rays in the later stages of tuberculosis in guinea pigs remains to be determined. The results obtained from these observations harmonize with the view that antibodies are produced in the spleen, lymphatic tissues, and marrow, as these structures suffer most directly from the action of the roentgen ray; they indicate also that one reason why the lymphocyte appears to be an important agent of defense in tuberculosis and other conditions may be its power to form antibodies and that the rapid development of tuberculosis in roentgen-rayed guinea pigs may depend, at least in part, on interference with antibody-production. L. HEKTOEN.

(*J. Infect. Dis.*, Chicago, January, 1918, 22, No. 1. Ref. *J. Am. M. Ass.*, Feb. 16, 1918, p. 486.)

POSTROENTGEN TREATMENT OF CARCINOMA OF THE BREAST *

BY RUSSELL H. BOGGS, M.D.
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THE technique of the treatment of carcinoma of the breast by the roentgen rays has been steadily improving. Since the introduction of the Coolidge tube many have been able to standardize their dosage. Some advances have also been made in deep therapy. However, in studying the work done by a large majority of roentgenologists, we find two serious defects. The first of these is, that they leave many chains of lymphatics untreated. And the second is that, while they give a physiological dose superficially, in cross-firing they employ too few ports of entry, so that as a result, the deep tissues receive only from 1/3 to 1/7 the physiological dose.

It is absolutely imperative that every roentgen therapeutist should make a comprehensive study of the lymphatics draining the breast before he attempts to treat mammary carcinoma. Since we know that the lymphatic supply to the breast is greater than that of almost any other organ of the body, and since we have learned from a study of bone metastases how extensively the lymphatics become involved, we realize that when we rayed only the line of incision, axilla and supraclavicular region, our treatment was very incomplete. It omitted a great number of glands which we now know it is necessary to treat, namely: suprascapular, paravertebral, supraxiphoid, lateral intercostal and inguinal group. Nor should we neglect to ray the internal mammary glands, since it is from these that the involvement from one breast to the other takes place.

Autopsy has shown that the liver is the seat of metastases more frequently than any of the internal organs, and in many cases becomes involved in comparatively early stages. According to Handley, the frequent involvement of the liver is attributed to the cancerous dissemination along the deep lymphatics of the fascia of the thoracic wall to the epigastrium and to the umbilicus, whence these cells follow the subserous lymphatics to become deposited either on the surface of the liver, or are conveyed along the lymphatics of the falciform ligament to the portal glands. If Handley's deductions are correct we should never omit heavy treatment over the epigastric region.

The next in frequency are the lungs, pleura and the glands of the mediastinum. These are supposed to become involved through the intercostal or supraclavicular lymphatics.

In some patients we find the pelvic viscera are involved. Handley says that these are involved in 8.6 per cent. of the early cases in young patients, and in only 4.8 per cent. of the late cases of all older patients. The reason for this lower percentage in older patients is, that with age the lymphatics undergo senile atrophy, and the diminution of the caliber of the lymphatic vessels always has a tendency to oppose cancer dissemination. This truth, that the smaller the vessels the more they oppose the advance of metastases, is also shown by the fact that the disease is not so malignant in thin patients as in those who are fat. Right here while this fact is before you, I would like to say that if the roentgen rays did nothing more than produce a sclerosis of the lymphatics and a reduction of the size of the vessels, the treatment would still be indicated, as it would always check the progress of the disease and in some cases effect a cure.

A study of autopsies shows that almost any organ of the body may show metastasis from cancer of the breast, and how-

* Read at Eighteenth Annual Meeting of the American Roentgen Ray Society, New York City, Sept. 20-22, 1917.

ever much confined to the superficial tissues this dissemination may seem to be, no one can absolutely foretell how far the so-called "microscopic growing edge" of cancer may extend. In 7 per cent. of the cases of carcinoma of the breast, bone metastases are a late sequel. Any bony structure may undergo metastasis, but the clavicle and the distal extremities are rarely involved.

In view of the wide distribution and depth of metastases, we know that in treating carcinoma of the breast, the rays must be so directed that the deep glands in the axilla, under the clavicle, in the mediastinum, those leading to the liver, and all the viscera which invite metastasis will receive a full roentgen dose. This means that cross-firing must be employed so that the deep glands will be given from 3 to 7 times the amount that is given to any skin area. If we give 20X Koenig (Gauss modified Kienböck scale) dose at the surface, in order that the tissues at a depth of two inches will receive 20X, sufficient ports of entry must be employed to make up for the amount of intensity of the light which is lost by distance and by absorption by the tissues. If the glands to be rayed are four inches from the skin, more cross-firing or more ports of entry must be used than if the glands are only two inches from the skin. Experiments have shown, if the glands to be treated are four inches below the surface, that the intensity diminishes from 100 to 15, that is about one-seventh of that at the surface. I am sure that the majority of those treating carcinoma of the breast by the roentgen rays employ too few ports of entry, and consequently the deep tissues receive only a fractional dose. This failure to employ deep therapy is responsible for many recurrences.

Most of us would like to give a more radical treatment in order to produce better end results. We know that all the glands which favor metastasis from breast carcinoma should receive deep radiation, but we must remember that the number of square inches that can be radiated is limited, when a full dose is given more than once. Now we are all looking for some means by which the skin will safely tolerate larger doses. Many roentgenologists have adopted the following or its equivalent as a standard dose, or the amount which each area of the skin will tolerate safely: Using a Coolidge tube and a modern transformer, focal-skin distance 8 inches, filtering the rays with 4 millimeters of aluminum, with a 9-inch parallel spark gap, 25 milliampere minutes are given. With most transformers this dose will measure 20X Koenig (Gauss modified Kienböck scale). This is the dose I employ in most cases, and I ray the following areas:

(1) In order to prevent recurrence in the wound and destroy any foci in the lymphatics of the anterior chest wall and those leading up to the inner clavicular area, three to four areas receive treatment, the last being directed towards the liver. Then the liver area is given one anteriorly, one laterally and one posteriorly. With this amount of treatment, the scar is nearly all removed and a recurrence in the area is rare, in comparison with the number of recurrences in cases not treated by radiation. The scar will not tolerate as much radiation as regions where the circulation has not been interfered with by operation.

(2) The axilla is given from three to four doses, in addition to what it receives indirectly while other areas are treated, so that it will receive a full dose at the proper depth. One area below the axilla laterally can be covered by one treatment. The supraclavicular glands are usually involved from the axillary.

(3) The supraclavicular region is divided into four areas. One treatment is directed obliquely inwards including the lower cervical glands, one downward through the shoulder area to the axilla, one obliquely downward and backward through the clavicle, and one obliquely forward and downward from the posterior surface. Care must be taken that the glands under the clavicle receive a full dose.

(4) The suprascapular area much more frequently discloses metastases than the subscapular. Each should receive a full dose on the affected side, while on the opposite side the subscapular area might be omitted in early cases.

(5) The mediastinum should receive one or two treatments from the posterior to an area between the spine and scapula of the opposite side directed towards the affected breast region, besides the treatment it receives when other areas are rayed.

(6) The opposite side is rayed according to indications, and during the course never receives less than from 4 to 8 treatments.

(7) The epigastric region must never be omitted, as this is one of the avenues by which the liver and pelvic viscera are invaded.

The interval between the first and second course of treatments is four weeks. However, in most cases the supraclavicular glands are rayed again in two weeks instead of four, since this chain is often involved, and the surgeon seldom advises opening it, because he has learned that it is really inoperable when involved. Competent surgeons agree that if an operation could be performed before a diagnosis could be made clinically and without a microscope, 80 per cent. of the cases could be cured.

Deaver and McFarland in their recent book, "The Breast, Its Anomalies, Its Diseases, and their Treatment," make the following statement: "It has been stated that 80 per cent. of patients in whom the disease is confined to the breast, as proved by both macroscopic and microscopic examinations of the tissues adjacent to this organ, are permanently cured of their disease by the radical operation. Therefore, a patient presenting a small movable mass localized to the breast can be assured that four out of five cases of a similar nature are cured by operation. When axillary lymph nodes are palpably enlarged as the result of metastases, the chances of operative cure are at once diminished to one in five." This deduction is practically the same as that of Halstead, who says that notwithstanding the present day extensive operation, death from metastases occurs in 23.4 per cent., even in cases with a microscopically negative axilla. Deaver questions whether as much palliation is received from operative as from non-operative methods, and expresses his general dissatisfaction with operations of a palliative nature in the treatment of carcinoma of the breast, since in certain cases the disease has been excited to greater activity by an incomplete operation, and the life of the patient considerably shortened. In this connection he mentions the unreserved statement of Bloodgood, that "Incomplete operation hastens death." He further states that since 1897 extraordinary advances have been made in roentgenotherapy that remove most of the indications for the ultraradical operative procedures, which have practically no curative value and a primary mortality of at least 25 per cent.

Since this carefully prepared volume of Deaver is a résumé of the entire medical literature and world-wide clinics, and since he has included a valuable chapter on roentgenotherapy by Pfahler, it deserves more than passing notice. For my own part, I am well convinced from the cases I have seen during the past fifteen or sixteen years, that proper postroentgen treatment will prevent from 25 to 50 per cent. of recurrences even in early cases, because cancer cells can be destroyed at a greater depth and distance from the original growth. It is only a question of time, until the profession will realize that postoperative treatment is just as necessary as is asepsis, before and during the operation.

For the last five or six years, I have considered anti-operative roentgenotherapy a very important and useful field in early as well as in advanced carcinoma of the breast, but only a comparatively few cases have been referred, as surgeons do not want the operation to be delayed for three or four weeks.

It is a demonstrative fact that in lym-

phatics, where the vessels are of a small size, carcinoma cells do not disseminate nearly so readily as where they are of a larger size. It has been proven that after roentgenotherapy, the lymphatics undergo a sclerosis, thus reducing the size of both the lymph nodes and vessels which in turn reduces the danger of metastases. A cancerous mass which has been rayed, changes in type, always becomes more scirrhous, and is rendered much less malignant. Carcinomatous tumors in the breast which have been growing very rapidly will be checked and reduced in size within a very short time after full doses of radiation. It has been suggested that some of the patients are rendered "immune" to the growth of carcinoma for some time after such treatment. However, no one can prove at present whether there is really an immunity, or whether the checking of the growth and improvement in the general health of the patient are due entirely to histological changes in the tissues. Observers agree that the type of tumor changes, and that the danger of metastases is reduced by such treatment.

Anti-operative treatment will often render a more advanced case operable, and if deep metastases have not already taken place, more permanent cures can be obtained surgically. As I have before mentioned, metastases will not occur so readily if the caliber of the lymphatic vessels has been reduced by treatment. However, if the liver or any other of the internal viscera had a metastatic involvement before treatment was given, the cure by operation would be only an apparent cure. But the operation would not hasten metastases as it would without anti-operative treatment. Postoperative roentgen treatment cannot take the place of anti-operative treatment-as many think.

We all know much palliation and many times a temporary cure can be produced in inoperable and recurrent cases. A study of the lymphatic supply of the breast and the extensive metastases, usually visceral, which have already taken place, explains why the results are often only temporary. By temporary, I mean from one to three or more years.

Although much advancement will yet be made in roentgenotherapy, sufficient results have been already obtained to make it a recognized method in the treatment of postoperative cases, recurrent and metastatic, primary inoperable and primary cases which cannot be operated upon.

AN INEXPENSIVE HEAD VISE

BY CAMP C. THOMAS, B.S.

ANN ARBOR, MICH.

RARELY does the initial installation of a roentgen laboratory include an efficient device for immobilizing the head while radiographing the sinuses. We met such a situation by constructing the "head vise" here illustrated and found it to be valuable in all views except the lateral. The total expense, including labor and materials, was seventy-five cents.

The base is made of pine 14″ x 10″ x ¾″. The jaws of the vise are mounted 4½ inches from one end of the base, and are five inches high, as illustrated here in Plate II.

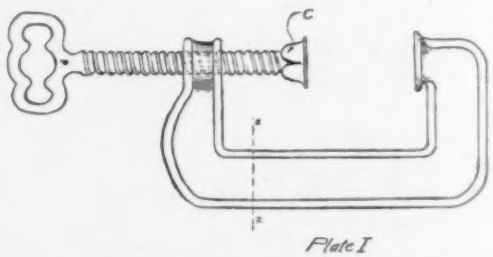

Plate I

The jaws are made by welding iron brackets to the part sawed from a carpenter's iron clamps, labeled N, in Plate I.

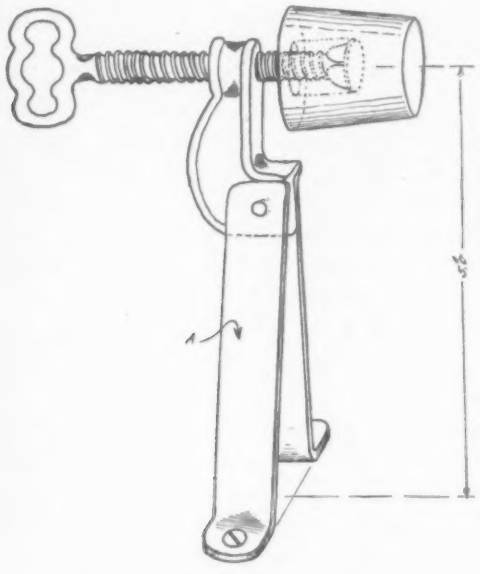

Plate II

The pivoted plate of the clamp jaw is imbedded in a large cork, and cemented or glued. The carpenter's clamps are made of cast iron and were purchased for ten cents each at a "5-and-10-cent store."

The corks used as faces of the vise jaws do not obstruct the rays and cast no shadows on the roentgenograph.

The vise may be used at an inclination of 25 degrees by raising one end of the base six inches with removable pegs.

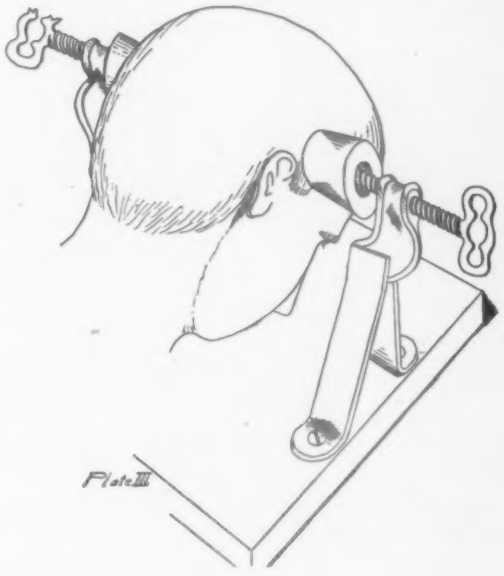

Plate III

In making stereoroentgenographs the aluminum plate-changing tunnel may be used with the vise, or the base may be made of light veneer with a plate-changing compartment.

THE AMERICAN JOURNAL OF ROENTGENOLOGY
PUBLISHED BY PAUL B. HOEBER, NEW YORK CITY

Issued Monthly. Subscription, $5.00 per year. Advertising rates submitted on application. Editorial office, 124 Manchester St., Battle Creek, Mich. Office of publication, 67-69 East 59th Street, New York

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GASTRIC FUNCTION FOLLOWING GASTRO-ENTEROSTOMY

Smithies[1] in discussing gastric function after gastro-enterostomy considers the development of pain, anorexia, nausea, vomiting, gas, eructations, constipation, diarrhea, weight loss, weakness, nervousness, gross hemorrhage, anemia, cachexia, jaundice, visible abdominal peristalsis, abdominal tenderness, and abdominal ridge or mass. A brief notice is made of "stomach size" and "gastric stagnation." He then considers in considerable detail the analyses of the gastric juice. The paper is purely a clinical study and as such is able, admirable and interesting. We are surprised, therefore, to have the paper end abruptly with the following paragraphs which we quote verbatim.

"Roentgen examinations: Fluoroscopic study was made of 39 cases within 7 weeks of gastro-enterostomy and of 26 cases operated upon from 6 months to 9 years previously. The results were so greatly at variance with the patient's physiologic digestive function or his clinical condition that we are still in doubt as to the clinical worth of the procedure. Apart from the screen and plate examinations demonstrating the patency or closure of the pylorus or gastro-enterostomy stoma, contractures of the stomach, incorrect surgical procedures, new ulcer or recurrences of ulcer or cancer, or anomalous pocketing or regurgitation of the opaque meal, little reliable information respecting gastric function was obtained. Many of these facts were clinically evident from simple routine examinations and from well-taken histories.

"In patients who have been operated upon at other clinics and in whom the surgical maneuvers are in doubt, fluoroscopic examinations furnish a valuable method for rapidly establishing the mechanical status of the stomach and the jejunum. However, in all cases, where stenoses, contractures, pocketings, or retention of the opaque meal appear to exist, frequent examinations, particularly after full doses of atropin or belladonna, should be made before opinion is given. Many abnormalities seen at the first seance disappear upon repeated examination, especially upon the examination after anti-spasmodic medicines have been administered."

[1] "Gastric Functions Following Gastro-Enterostomy," *Surg. Gynec. & Obstr.*, March, 1918, p. 281.

This comment on gastric roentgenology is interesting chiefly because it illustrates the irrational animosity which the distinguished author seems to entertain and cultivates towards the *x*-ray.

In his entire article he touches upon only two conditions which could by any possibility be demonstrated by *x*-ray methods; namely "stomach size" and "gastric stagnation." In his sneering disparagement of the *x*-ray he does not mention either of these conditions in connection with his own cases. In the final paragraph he mentions "the mechanical status of the stomach" and *the apparent* retention of the *opaque meal*, in connection with cases "operated upon at other clinics." But he does manage to mention a fairly wide range of *x*-ray usefulness. His style in this regard if applied to urinalysis would read somewhat as follows: The examination of the urine apart from showing the presence of albumin, sugar, casts, indican, pus, the reaction, the phthalein index and the specific gravity contributes but little information respecting the renal function.

He estimates the size of the stomach by air inflation, at the same time apologizing for its inaccuracy. For the estimation of gastric stagnation he uses the stomach tube. If a few bits of raisin skins or lettuce leaves have adhered to the stomach wall, then the stomach is adjudged to show food retention. So particular is he in this regard that the stomach is "lavaged with 2 liters of warm water in order to avoid missing retention of food bits."

While he is insistent that stomach retention after an opaque *x*-ray meal must be guarded by repeated examinations after full doses of atropin, he ignores entirely the fact that gastric and pyloric spasms are exactly as common after a stomach-tube test-meal as when barium is mixed with the food. Dr. Smithies is not to be judged more at fault in this matter than other internists who hold the *x*-ray strictly accountable to fallacies and methods discovered and prescribed by roentgenologists, while forgetting that clinical methods in no way absolve the stomach from its peculiar spasms and responses to reflex influences.

In contrast to Smithies' unwarranted statements we may quote from Carman and Miller's paper[2] based upon 950 cases at the Mayo Clinic in which both the *x*-ray and the clinical methods of estimating gastric retention were compared. Conclusions:

"1. It would seem that the bariumized carbohydrate meal described above is a more sensitive test for gastric motility than the modified Riegel meal as commonly used in the Mayo Clinic.

"2. The roentgenologic double-meal method is more informative than tubing after a motor test-meal, since the former not only shows delay of evacuation beyond six hours, but also yields information as to hypermotile conditions, and often, by showing both the active and passive factors concerned in motility, aids in the judgment of the net result.

"3. A distinct residue after six hours from the barium meal given under the conditions prescribed has been, nine times out of ten, in our experience, indicative of grave pathology and usually denotes obstruction at or near the pylorus.

"4. The roentgenologic method is probably capable of further elaboration and refinement. By this means the motility of the stomach for various foodstuffs, given separately and in combination, can be determined with ease and accuracy, and by such determinations the diagnosis of gastric disorders might be further promoted.

"5. The six-hour barium residue may be the most definite and striking roentgenologic sign of a gastro-intestinal lesion. Other signs may be so slight and indefinite that a diagnosis might not be ventured without this retention."

The confidence of the medical profession in gastric roentgenology need in no respect be impaired because of Dr. Smithies' failure to find it useful in the examination of cases after gastro-enterostomies.

A. W. CRANE.

[2]Collected Papers of the Mayo Clinic, Vol. VII, 1915, p. 96.

Use of Intensifying Screens for Skeletal Roentgenography

The conviction of most experienced roentgenologists is that the intensifying screen, although very useful in gastro-intestinal work, is to be avoided in the roentgenography of bones and joints. This conviction is not to be disputed in the case of the average patient of 150 pounds or less. But there comes a point with increasing thickness of parts where the screened plate may be made superior to the unscreened plate, provided a certain technique be followed.

The parts of a heavy patient especially suited for the screened plate are, the spine, both anteroposterior and lateral, the hips and the shoulders. Here it may be necessary with unscreened plates to use small diaphragms and long exposures. For these reasons the use of stereoscopic plates may be often impracticable. But better plates, with larger diaphragms and in quicker time, may be made with screens.

The technique is simply the use of a soft ray, a transformer current of low voltage, sufficient time, and an aluminum filter between patient and plate to cut out a proportion of the secondary rays. It is important to use a current of low voltage yielding a maximum of a 5 or 6 inch spark. The tube should be regulated so that 1 second may be allowed for every 3 centimeters of tissue thickness when 35 to 40 milliamperes are flowing through a Coolidge tube with a tube distance of 24 inches. This should give a parallel spark gap of from 3½ to 4 inches. The secondary rays generated in the tissues by these soft rays are partly stopped by the ordinary aluminum cover of the cassette, but it is better to add ½ cm. thickness in addition to improve the definition.

It will be seen that the time is about one third that of the unscreened plate if a 4 to 4½ parallel spark gap is used. This is a very different matter from the so-called instantaneous exposures usually associated with the use of intensifying screens. From 5 to 15 seconds for spines are needed for this method in contrast to 1/10 to 1/3 second used in gastro-intestinal plates in the same cases.

This same technique applied to the roentgenography of the head is especially useful. The average anteroposterior plate is thus made in 7 seconds with a distance of 16 to 18 inches while the lateral at 24 inches is made in the same time. We have found it especially useful to make the first plate of a stereoscopic pair of the head on an unscreened plate and to make the second on the screened plate. The fine focus Coolidge tube is thus saved from overheating. The two plates stereoscope extremely well, the difference in tone, structure and detail contributing to the stereoscopic effect, while the grain of the screen becomes partially effaced by the superposition of the unscreened plate. The fact that in the stereoscope one plate must have the glass side out while the other has the film side out, in no way detracts from the practicability of this method.

In order to use a plate-changer holding cassettes, the unscreened plate may be put into an empty cassette or a piece of black paper may be fitted over the screen and the plate placed upon it so that the film side will be presented to the rays.

Our work in this line has been done exclusively with fine focus Coolidge tubes. Accuracy of adjustment and great steadiness in the character of the rays are required. It is altogether probable that a steady gas tube could be used with equally good results if managed with sufficient care. It is obvious, if the tube hardens under fire or softens with heat, that either the plate will be gray and flat from too high a ray, or be underexposed from insufficient penetration. Thus the method has the disadvantage of a narrow range for variation of ray-penetration.

A. W. Crane.

TRANSLATIONS & ABSTRACTS

COOLIDGE, W. D., AND MOORE, C. N. A Portable Roentgen Ray Generating Outfit. (Research Laboratory General Electric Co. *General Electric Review*, January, 1918, Vol. XXI, No. 1, p. 60.)

The authors became interested in the problems of a portable military *x*-ray outfit because of inquiries from the Red Cross when it appeared that this country might become involved in the European war. Existing military outfits were investigated and experiments carried on regarding six possible systems. The following is quoted from their article.

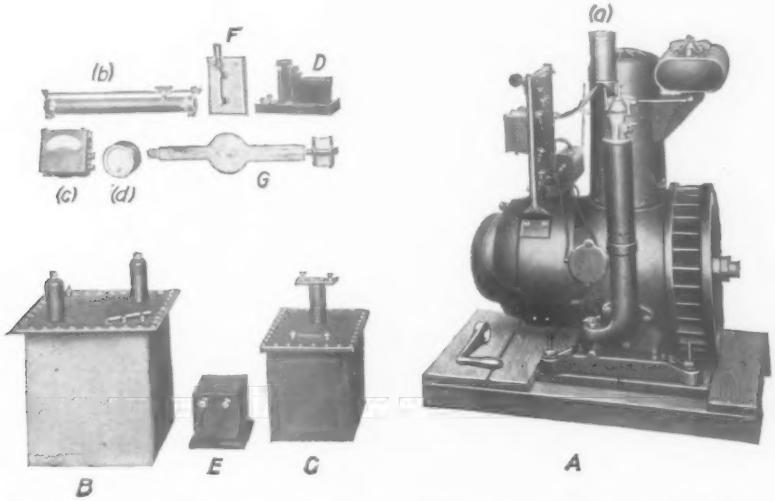

FIG. 1. SEPARATE UNITS COMPRISING PORTABLE ROENTGEN RAY OUTFIT.

THE SYSTEM CHOSEN

System (4), consisting of a gasolene-electric set furnishing alternating current to a step-up transformer, and with a special self-rectifying roentgen ray tube operating directly from the latter was finally chosen. The advantages of this system when compared with the others may be briefly summarized as follows:

It is simpler.
It is more efficient electrically.
It is lighter in weight for a given output, and hence more portable.
It does not involve the care of a storage battery.
It involves the use of no moving parts other than the gasolene-electric set.
The outfit is self-contained, requiring merely gasolene to run it, and hence can be operated anywhere at any time regardless of the presence or absence of electric supply circuits.
The one member having moving parts, namely the gasolene-electric set, can be located at any desired distance from the roentgen ray room.

THE OUTFIT AS DEVELOPED

Separate Elements Comprising the Outfit.—Having settled upon the system, it became necessary to get the component parts. The exigency of the case made it desirable to use, in so far as possible, apparatus which was already in production and hence readily available. For this reason, apparatus was borrowed from many different manufacturers and tested for its fitness for the particular purpose in question. The elements which were finally chosen are shown in Fig. 1. A description of each of these elements, together with the reasons for choosing it, is given in the following:

(*A*) *Gasolene-electric Set.*—Various single- and multiple-cylinder engines of the 2-cycle and 4-cycle type were tried out, and the conclusion was reached that the one which was best adapt-

ed to the purpose was the Delco-light engine made by the Domestic Engineering Company of Dayton, Ohio. This engine was already direct-connected to a dynamo.

The Delco-light set was originally built for direct current at 40 volts, but by a change in armature- and field-windings and by the addition of a pair of slip rings and brushes it was adapted to furnish alternating current at the desired voltage. The engine was also provided with a special throttle-governor for regulating the generator voltage. This governor consists of a solenoid (a) mounted above the carburetor, the movable core of the solenoid being connected to the butterfly valve of the throttle. The solenoid is operated by direct current taken from the commutator of the generator. A variable resistance (b) is placed in series with the solenoid, and by means of this resistance any throttle opening and hence any desired engine speed and alternating current voltage may be obtained. The alternating-current voltage is indicated by the voltmeter (c).

(*B*) *Roentgen Ray Transformer.*—A small transformer for dental radiographic outfit, was chosen for the following reasons:

It is an oil-insulated closed-magnetic circuit transformer of the proper capacity.

It is oil-tight.

Its design is such that, with the load in question, the "inverse" voltage is not prohibitively high.

It was available on short notice, as only two minor changes were required. These changes consisted in adapting the primary winding to the voltage of the generator and in bringing out leads for the milliammeter (d) from the grounded middle point of the secondary (this makes the milliammeter a low-tension instrument).

(*C*) *Filament-current Transformer.* — Here again it seemed imperative that an oil insulated transformer should be used, and that this should be electrically efficient, of light weight, and oil tight.

(*D*) *Filament-current Control.*—That chosen for this outfit was selected because of its small size, fineness of regulation, and the fact that the setting, once made, was not easily disturbed.

(*E*) *Booster.*—The line voltage drops considerably when the full load is thrown on the generator. To prevent the lowering of the filament-current which would result from this, a small transformer was designed, the primary of which is inserted in the primary circuit of the *x*-ray transformer and the secondary in the primary circuit of the filament-transformer, as shown in the wiring diagram (Fig. 3).

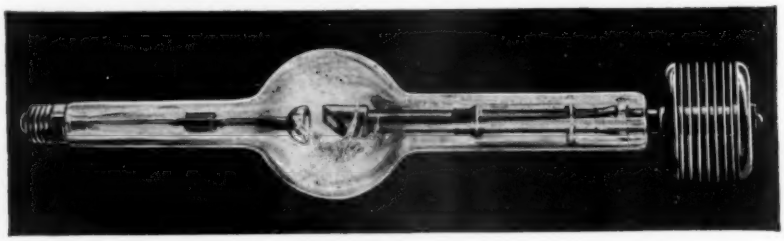

Fig. 2. Special Self-rectifying Roentgen Ray Tube.

(*F*) *Operating Switch.*—A single-pole single-throw switch of substantial construction was chosen.

(*G*) *Special Self-rectifying Tube.*—There was no tube suitable for diagnostic work and capable of rectifying its own current, for frequent long exposures, with as much energy as that available from the Delco-light set. It, therefore, became necessary to undertake its development, and the result is seen in Fig. 2. This tube is fully discussed in a separate paper published in the current number of the *Review* by one of the authors. Briefly, it is a hot-cathode tube with a 9.5 cm. ($3\frac{3}{4}$ in.) bulb. The cathode has been especially designed to give a focal spot 3.2 mm. ($\frac{1}{8}$ in.) in diameter and with a very uniform distribution of energy. The target consists of a small wrought-tungsten button set in a solid block of copper, and this block is electrically welded to a solid copper stem 1.6 cm. ($\frac{5}{8}$ in.) in diameter which extends out through the anode arm to an exter-

nal radiator. A platinum sleeve is silver-soldered at one end to the copper stem and attached at the other end to the glass of the anode arm. The target, complete with stem and radiator, weighs 860 gms. and has a heat capacity of 81 calories per degree centigrade. The present standard solid tungsten target,

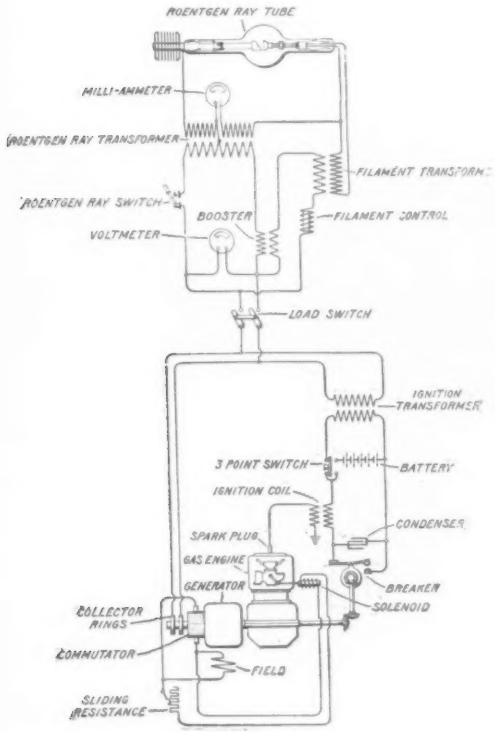

FIG. 3. COMPLETE WIRING DIAGRAM.

complete with molybdenum stem and iron supporting tube, has a heat capacity of less than 10 calories. Because of its greater heat capacity, it takes much longer to heat the radiator type of target to redness than it does the solid tungsten target. Unlike the latter, the target in the new tube, even at relatively low temperatures, cools rapidly in the interval between radiographic exposures, and, therefore, permits of starting each exposure with an essentially cold target. As a result the focal spot, even though small, is kept from reaching a temperature high enough to allow "inverse" current to pass through the tube. Furthermore (and this serves as an additional safeguard), this type of tube does not allow an appreciable amount of inverse current to pass even though it is so badly overloaded that the focal spot becomes heated to the melting point. A probable explanation of this striking fact is given in the companion article on the tube.

COMPLETE WIRING DIAGRAM

This is shown in Fig. 3 and needs no further explanation.

COMPLETE OUTFIT

The complete outfit is shown in Fig. 4, in which the gasolene-electric set is seen at the left. The roentgen ray and filament-current transformers, the filament current control, and the booster are in the lower part of the box at the end of the table (see Fig. 5, which shows the inside of this box). On a shelf in the top of this box are a voltmeter for showing line voltage, the adjustable rheostat for controlling line voltage, a milliammeter for indicating the tube current, and the operating switch. (There is a cover for this box which is screwed on for shipment.) The *x*-ray tube is permanently located in the movable tube box under the table.[1]

TECHNIC

The outfit as described lends itself readily to a very simple technic. Experience extending over several years has convinced the writers that it is very convenient, for experimental work, to have extreme flexibility in a roentgen ray generating outfit, so that the penetrating power of the rays can be varied at will between wide limits. It has also convinced them, however, that roentgenologists would get better average results in diagnostic work if their outfits were made much less flexible, so that the roentgen ray tube could be used more, for example, as the ordinary incandescent lamp is. When such a lamp is lighted on the ordinary constant-potential circuit, it gives always the same kind and the same amount of light. It is entirely practicable to operate a roentgen ray tube in this same manner. It is merely necessary to see that the filament current is always the same and that the high-tension voltage impressed upon the tube terminals is always the same. Under these circumstances the tube always gives out roentgen rays of the same penetrating power [2] and of the same intensity. More

[1] The table, tube box, and shutter were all developed by the cooperative work of others, including Major Shearer, Major Geo. Johnston, and the Kelley-Koett Company.

[2] These rays are not homogeneous, but the mixture is always the same.

artistic radiographs can be made by adapting the penetrating power of the rays to the thickness of the part to be radiographed, but experience shows that with a suitable compromise voltage (we have adopted that corresponding to a 5-in. spark between pointed electrodes which is equal to 57,500 volts effective, as actually measured by a sphere gap) excellent radiographs can be made of all parts of the human body, and with a great simplification in apparatus and technic. The time factor becomes the only variable and this is adapted to the thickness of the part to be radiographed.

With 57,500 volts (effective) and 10 milliamperes and a distance of 45.7 cm. (18 in.) from focal spot to plate, the writers have found that for Seed plates and the average adult subject, the following table of exposures gives good results:

Exposures 18 in. distance

	Sec.		Sec.
Hand	1	Chest	10
Elbow	2	Hip	20
Ankle	2	Head-lateral	25
Knee	4	Frontal sinus	50
Shoulder	8		

Too much weight should not be attached to this table, as it is based on a relatively small amount of work. It is merely given to show in a general way how the time of exposure varies for different parts of the body when the intensity and penetrating power of the rays are held constant.

The compromise voltage used for radiography appears well suited to fluoroscopy, and at this voltage a current of 5 ma. appears to give sufficient illumination.

The reason for adopting for radiography the amount of energy corresponding to 10 ma. at a 5-in. spark was that it was the maximum amount available in the tube when operating from the Delco-light generator.

This energy could, of course, have been taken at any desired potential, as this was merely a matter of transformer design. The reasons for choosing the potential corresponding to a 5-in. spark were: Given a certain amount of energy to work with, the roentgen ray intensity, as measured by the illumination of the fluorescent screen or the action on the photographic plate goes up rapidly with the voltage. This is obvious from the well-known fact that roentgen ray intensity, measured as above, increases with the first power of the milliamperage and with the square of the voltage, while the energy delivered to the tube is proportional to the product of the first power of the current and the voltage. This, then, was an argument in favor of high voltage. On the other hand, contrast, in both radiography and fluoroscopy, decreases with increasing voltage. This is an argument against the use of too high voltage. The voltage corresponding to a 5-in. spark between points appeared to be a good compromise.

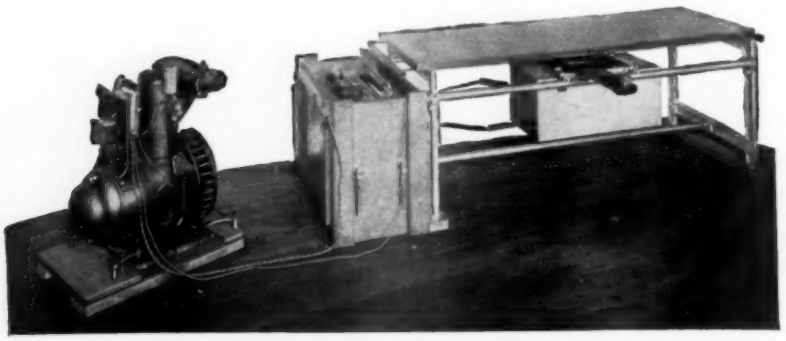

FIG. 4. COMPLETE PORTABLE ROENTGEN RAY OUTFIT.

The authors have adopted the following general method of using the outfit.

After starting the engine, the resistance (b) is all cut out. This causes the engine to idle at its lowest speed.

For radiographic work, the resistance of (b) is raised until the line voltage indicated by (c) is about 160. The filament current is then ad-

justed once for all[3] by means of the control (D) until, upon closing the *x*-ray switch, the milliamperemeter registers 10. As the *x*-ray switch is closed the line voltage is seen to drop. The resistance of (b) should be changed until the line voltage, with the 10 ma. load, is 122. The line voltage is now observed when the load is taken off, and is in future work brought

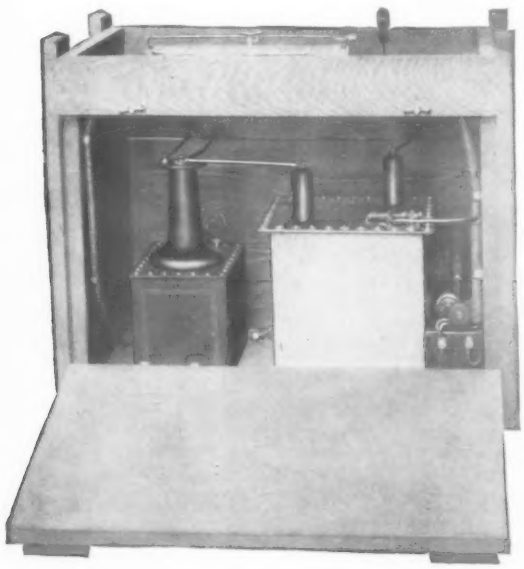

FIG. 5. TRANSFORMER AND INSTRUMENT BOX.

to this point before closing the roentgen ray switch. The important point is that the voltmeter reading when the 10 milliampere load is on shall always be 122. If this condition is fulfilled, all radiographic work will be done with a tube voltage corresponding to a 5-in. spark between points.

For fluoroscopic work, it is not necessary to touch the filament current control. This should be left just as it was for radiographic work. After closing the roentgen ray switch, the rheostat (b) is so adjusted that the tube carries 5 milliamperes. The tube voltage will then be the same as it is with the 10-ma. setting for radiographic work.

ENGINEERING DATA

(*1*) *Electrical Efficiency.*—Wattmeter measurements taken at various points in the circuit showed that, with the radiographic load of 10 ma. at 57,500 volts (effective), the alternating-current generator was delivering 820 watts, and that this energy was consumed in various parts of the outfit as follows:

	Watts
Main line loss	10
Booster loss	12
Filament-current control loss	14
Filament-current transformer loss	5
Energy consumed in filament	43
Energy delivered to roentgen ray transformer	694
Total	778

The difference of 5 per cent. between this total and the 820 watts measured directly at the brushes of the generator is doubtless to be explained in part by experimental error and in part by distortion of wave-form.

From the above, it is seen that 85 per cent. (694 watts) of the energy from the generator is delivered to the roentgen ray transformer.

The energy in the high-tension discharge passing through the tube was not measured directly. (If time had permitted, it would have been determined by thermal measurements of the heat generated in the target.) It should be approximately equal to 575 watts (the product of tube current and voltage, or 0.010 by 57,500). *According to this, the roentgen ray tube gets, in the form of high-tension discharge, 83 per cent. of the energy delivered to the roentgen ray transformer and 70 per cent. of the total energy delivered by the alternating-current generator.*

(*2*) *Gasolene Economy.*—This was determined for various roentgen ray loads. In the following table, the first column gives the number of the experiment, the second the load, the third the engine speed in revolutions per minute, the fourth the dynamo voltage, and the last the economy expressed in hours of operation per gallon of gasolene consumed.

Expt. No.	Roentgen ray Load	R.p.m.	Dynamo Voltage	Hours per Gallon
1	0	900	90	5½
2	0	1440	160	4
3	Radiographic	1382	122	3½
4	Fluoroscopic	1320	114	3¾

In Experiment 1, the engine was idling at its lowest speed and the roentgen ray switch was open. In Experiment 2, the engine speed was that required for radiographic work, but the roentgen ray switch was open. In Experi-

[3] It should subsequently need to be changed only when tubes are changed.

ment 3, the radiographic load is on for 15 seconds and then off for the remaining 45 seconds of each minute. (This particular schedule was chosen as representing the severest radiographic service which was likely to be required of the outfit.) The fourth experiment was with a fluoroscopic load kept on continuously.

(3) *Weights.*—The weight in pounds of the different parts of the outfit is given in the following table:

Engine and generator, with wooden base	377 lbs.
Tube box and shutter	110 lbs.
Table	164 lbs.
Transformer and instrument box with contents	244 lbs.
Total	895 lbs.

ADVANTAGES OF THE OUTFIT

The advantages of the complete outfit, as described above, may be summarized as follows:

(1) Simplicity of apparatus.
(2) High efficiency with consequent light weight and portability.
(3) No moving parts other than the gasolene-electric set.
(4) Control of line voltage, making it possible to duplicate electrical conditions and *x*-ray results very accurately.
(5) The tube has been designed to carry all of the energy that the generator can deliver. For this reason no harm can be done to the tube by raising the filament current too high. Under such conditions the milliamperage will go up, but the voltage will decrease so that the energy delivered to the tube will not go up appreciably.
(6) The gasolene-electric set can be placed at any desired distance from the high tension part of the outfit, so as to avoid noise in the operating room.
(7) No storage battery to get out of order.
(8) Engine can be made to idle at very low speed, conducive to long life. This advantage comes from the use of the voltage governor instead of a speed governor.
(9) An accidental short circuit of the generator does no harm; it simply lowers the line voltage to such an extent that the field excitation goes down, the ignition fails, and the engine stops.

IMPROVEMENTS WHICH COULD BE MADE BY SPECIAL DESIGN

The outfit described was developed primarily for army use, and the exigency of the case made it necessary, in so far as possible, to make use of parts which were already in production and hence readily available. It could be further simplified and improved by special design.

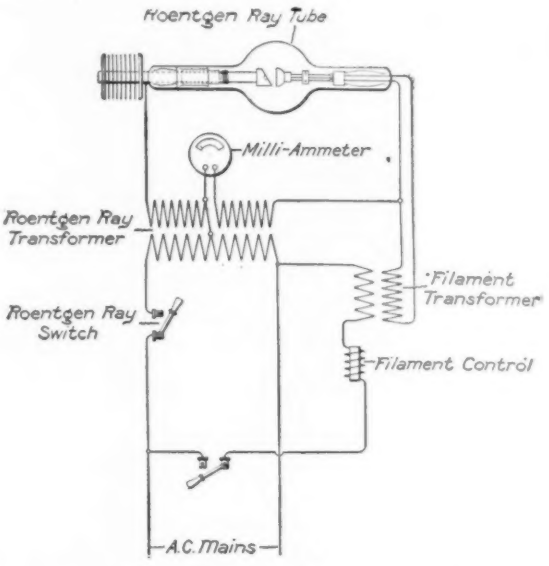

FIG. 6. WIRING DIAGRAM FOR OUTFIT OPERATED DIRECTLY FROM EXISTING ALTERNATING CURRENT MAINS. (WHEN GASOLENE ELECTRIC SET IS NOT NEEDED.)

The greatest improvement would come from a reduction in the "inverse" voltage. By proper electrical design of the dynamo and the high-voltage transformer, this "inverse" voltage could readily be reduced to a point where it would be but slightly in excess of the "useful" voltage.

This would make it practicable and easy to work with a high-tension system grounded on one side. The cathode of the tube would then be connected to the lead covering of the tube box, and through this and the supporting mechanisms to the grounded metal frame of the table. There would then be only one high-tension terminal to the transformer and only one high-tension wire going to the tube (to the anode). The grounding of the cathode end of the tube would make it possible to dispense with the relatively bulky filament-current transformer insulated for high potential and

to replace it with a very small ordinary low-voltage transformer. It would also, for the following reasons, increase the allowable tube travel: first, the grounded end of the tube could safely be moved to the extreme end of the table; and, second, owing to the reduction in inverse voltage, the length of tube and tube-box could be materially reduced.

The set described is intended to be used as a unit; but it would be a simple matter to so modify it that it could be operated from existing electric circuits without running the gasolene-electric set. The wiring diagram (Fig. 6) shows the simplicity of such a system. Where different line voltages are to be encountered, the roentgen ray and filament-current transformers would have special primary windings with several taps, or with several sections which could be connected in series or in multiple. Another method of accomplishing the same result would consist in using an auto-transformer provided with suitable taps to take in current of any commercial voltage and deliver it at the 122 volts given by the Delco-light set. There is already sufficient iron in the transformers to take care of a wide range of frequencies. For operation from direct-current mains, a rotary converter would be needed. When operating from existing electric mains, with either alternating or direct current, the booster would not be needed.

In closing the authors wish to express their thanks to the many different manufacturers who loaned the apparatus used in the investigation of the different systems referred to in this article.

SWAYNE, W. C. Rectal Diverticula as a Causative Factor in Pelvic Inflammation in Women. (*Bristol M.-Chir. J.*, 1917, XXXV, 91.) (Ref. *Internat. Abstr. of Surg.*, Jan., 1918, p. 34. Tuholske.)

Diverticula occur most frequently in the sigmoid, descending colon, and peritoneal-covered portion of the rectum. These diverticula are actual herniæ in the wall of the intestine, at the points of attachment of the appendices epiploicæ, with protrusion of the mucous membrane. They commonly contain fecal concretions; perforation is not an uncommon complication.

The author cites two personal cases, in one of which perforation had taken place leading into the bladder.

Operation aims at ligature of the pedicle of the diverticulum and invagination, but inasmuch as multiple diverticula usually exist, frequently imbedded in adhesions, and the disease occurs chiefly in elderly females, the operative risk is great. Medical treatment is of no avail. Diverticulitis should be considered as a possible factor in all pelvic inflammation of obscure origin.

CHAPIN. Comparison between Clinical Examination and Roentgenograms in Diseases of the Chest. (*Am. J. Obst. & Dis. Women & Child.*, Oct., 1917, Vol. LXXVI, No. 478.) (Ref. *Am. J. Med. Sc.*, Jan., 1918, Vol. CLV, No. 1, p. 143.)

Owing to the difficulty of keeping little children quiet during exposure it is often hard to interpret heart shadows. A twisting of the body may cause a rotation of the chest so as to exaggerate the heart shadow in any direction. Of 15 cases studied both by *x*-rays and by physical examination, 7 showed an agreement, or partly agreed, and 7 failed to show a correspondence in the conclusions reached by the two methods. In regard to the lungs a combined study was made in 97 cases. There was agreement in 77 and disagreement in 20 cases. Of the latter 5 gave evidence of lobar pneumonia that was not detected by physical examination; 2 gave physical signs of pneumonia, which were not confirmed by *x*-rays; 3 showed physical signs of bronchopneumonia not found in *x*-rays. As a general rule it was found that the *x*-rays would often give a shadow in the absence of physical signs in congestion, small consolidations, hilum infiltrations, interlobar pleurisy, miliary tuberculosis and mediastinal tumors.

HAMBURGER, WALTER W. Roentgenological Studies in the Healing of Gastric and Duodenal Ulcers. (*Am. J. M. Sc.*, February, 1918, Vol. CLV. No. 2, p. 204.)

Hamburger for the past two years has studied gastric and duodenal ulcer by the following method:

"1. In addition to the regular routine of history-taking, physical examination, test-meal examination, etc., the patient is subjected to a thorough preliminary roentgenological

study, including the registering of from six to twelve plates, taken at intervals after the barium meal.

"2. In the event that positive roentgenographic evidence of ulcer is thus obtained, the patient is put under medical treatment (the details of which do not concern us here) for from three to six weeks. Within this time and before discharge from the hospital the patient is again thoroughly studied roentgenologically, including the making of plates.

"3. The patient is asked to report back to the hospital at least every three months for a repetition of the roentgenographic studies.

"In other words, roentgenological examinations are made before, during, and after medical treatment, as often as every three months, for a period of one to two years or longer. These studies serve as a guide to the healing process, and as a contrast with the findings before treatment was begun."

Four duodenal and seven gastric ulcer cases were thus studied.

"Haudek, in 1910, described his classical Nischen Symptom, which was the demonstration roentgenologically of a small round projection (Ründliche Vorsprung) along the lesser curvature of the stomach. Haudek believed that this projection or pocket represented the accumulation of bismuth or barium in the crater of a penetrating ulcer. In certain cases the pocket or crater of bismuth was surmounted by a small air bubble which could be observed in the plate.

"Accepting, then, as definitely established, that the barium projection represents the ulcer crater, let us turn to a consideration of the changes in morphology of the niche during and after medical treatment. In certain cases the depth and width of the projection gradually lessens until, in the favorable cases, it has entirely disappeared, leaving a smooth, regular, lesser curvature outline. This disappearance of the niche can be followed accurately from week to week and month to month, and is usually accompanied with coincident improvement in the clinical findings, viz., disappearance of epigastric pain and distress; cessation of vomiting; disappearance of occult blood in stool and stomach contents; gain in weight, appetite, hemoglobin, and general well-being of the patient; gradual return to normal of gastric secretion and motility. Such ulcers may be said to be healing, and in the event that these objective and subjective changes continue satisfactorily, may, at the end of six to twenty-four months, be said to be cured, depending on the personal conservatism of the observer.

"Certain other cases, however, do not progress so satisfactorily, either because of insufficient dietary care on the part of the patient, inaccuracy in the details or duration of medical management, or because of other underlying organic disease, such as carcinoma, syphilis, or tuberculosis. In these ulcers the niche narrows only temporarily, later resuming its former contour or even becoming deeper, wider, and more irregular. Such patients demand either more accurate medical management, specific tuberculous or luetic treatment, or surgery—or all three.

"This method applied to cases of duodenal ulcer has not, up to the present, been productive of as many positive findings as in the case of lesser curvature ulcer. Notwithstanding it would appear that such repeated roentgenological examinations are of value and should be instituted as a routine in the medical treatment of all ulcers.

"1. This method is of value in the diagnosis, prognosis, control of medical treatment, and selection for surgical treatment of gastric and duodenal ulcer.

"2. The method is of value in studying the pathology of the healing process in both clinical and experimental ulcer. Thus far it is not of positive value in the differential diagnosis between ulcer and cancer, although in the future it may shed some light on the much discussed problem—the frequency of malignant degeneration of callous ulcer.

"3. In the use of the method the danger of mistaking normal peristalsis for penetrating ulcer and of the overlooking of the presence of small ulcer because of incomplete or insufficient examination must be borne in mind."

BOAS, ERNST P. AND SCHOLZ, THOMAS. Calcification in the Pineal Gland. (*Arch. Int. Med.*, January, 1918, Vol. 21, No. 1, p. 66.)

Many roentgenologists have puzzled over the significance of the dense particle which they see suspended in the mid-brain when examining stereoscopic plates of the head. This particle varies in size from a pin-head to a small pea and is located slightly above and 4

to 5 cm. behind the sella turcica. Boas and Scholz were able by postmortem to demonstrate the basis of this roentgen finding.

"Roentgenologic examination of the skull with the patient in a lateral position presented a dense, somewhat irregularly outlined shadow of about the size of a split pea, 4 or 5 cm. posterior to and somewhat above the tip of the posterior clinoid process. In both lateral views the shadow appeared of exactly the same size. The cranial bones failed to show any abnormality."

The following is from the necropsy protocol:

"The pineal body is slightly enlarged. It is calcified in large part. The calcium is deposited as a loose, spongy framework, chiefly in the upper half of the gland. A few small calcified plaques 1 or 2 mm. in diameter project from the posterior surface of the pineal gland into the third ventricle. There is no acervulus in the choroidal plexus or in the ependyma covering the trigonum habenulæ.

"Many sections were taken for microscopic examination. In the lower half of the gland the normal cellular structure persists. The nuclei are well preserved, large and vesicular, with a moderate amount of chromatin. There is apparently some increase in the fibrous stroma of the gland. Scattered here and there are many small grains of typical brain sand (*acervulus cerebri*). They stain blue with hematoxylin and are laid down in concentric lamellæ. They are approximately circular in shape but their margin is irregular. There is no tissue reaction about them, but they lie apparently free in between the glandular tissue. The upper portion of the gland is largely replaced by an irregular, blue-staining mass. On close inspection it is apparent that this mass has been formed by the fusion of innumerable small grains of acervulus. Under the high power the concentric rings of each grain can still be distinguished. The tissue between the adjacent granules stains less deeply with hematoxylin, and appears to be less deeply infiltrated with calcium. About the periphery of this mass of fused granules of brain sand there are many discrete granules similar to those first described. However, many of them have become agminated into small, mulberry-shaped masses. In one small area in the lower portion of the gland, rather wide, anastomosing trabeculæ of delicate, fibrous tissue enclosing many small capillaries divide the glandular tissue into imperfect alveoli. The blood vessels are normal. The blood vessels of the choroidal plexus are normal. Its epithelium is low cuboidal in type, with well staining nuclei. A few small granules of acervulus are present.

"Acervulus cerebri or brain sand is found very frequently in the pineal gland, in the choroidal plexus and in the neuroglia covering the commissura habenulæ. It is present as early as the seventh year of life and increases in amount with age. The concretions are sometimes mulberry-shaped, and are composed of calcium phosphate and carbonate. Krabbe, in his study of over a hundred pineal glands, saw these concretions very often. In studying serial sections he found that they are completely surrounded by parenchyma without being in contact with the connective tissue. In a few cases he observed calcifications in the connective tissue septa. These were very small and of an oblong shape. Marburg believes that brain sand is the first sign of involution of the pineal gland. The earliest deposition is in the commissura habenulæ. An increase in the size and number of the connective tissue septa, with calcification, may occur. Through apposition and fusion the corpora arenacea may assume many shapes. The size of the concretions varies from the size of a leukocyte to one third of the size of the gland. As far as Marburg could determine, age is the only factor predisposing to the calcification of the pineal gland.

"Whatever function the pineal gland may have is exercised before puberty. The pineal secretion is supposed to inhibit growth. With pineal disease this inhibition is removed and there is adiposity, general bodily overgrowth, with precocious sexual development, increase in size and development of the sex organs, and precocious change of voice in boys. After puberty the pineal gland undergoes involution, and so one would not expect symptoms from pineal calcification after adolescence."

BOOK REVIEWS

THE SURGICAL CLINICS OF CHICAGO, Vol. I, No. 5, October, 1917. Octavo of 214 pages with 84 illustrations. Published bi-monthly by W. B. Saunders Company, Philadelphia and London. Price per year: Paper $10.00; Cloth $14.00.

This number of the Surgical Clinics is of special importance, containing several valuable clinics summarizing experiences gained in European military hospitals; a very complete index to the year's volumes; and of particular interest to roentgenologists, two clinics relating to radiotherapy.

The first, by Bevan, relates to a case of roentgen ray burn of the anal region, following roentgenotherapy for a distressing pruritus ani. The skin around the anus was very badly burned for an area of six or seven inches in length and two and one half inches in width. The author does not recall having seen an individual who has suffered more than this particular patient. Various consultants had agreed that a plastic operation was necessary, and some had given the opinion that a preliminary colostomy was advisable in order to place the parts at rest during the convalescence. Under anesthesia, the patient lying on the face with the buttocks well elevated, the damaged skin was freed through a longitudinal incision of generous dimensions, the mucous membrane of the rectum dissected up for a distance of three quarters of an inch, and the entire flap of damaged skin removed. This left the uninjured mucous membrane projecting about half an inch beyond the sphincter. The line of incision was then closed, without difficulty, by tension sutures of silkworm gut, and the mucous membrane sewed with a large number of fine silk stitches to the skin. The result of the operation was most satisfactory. The pain from the roentgen ray burn disappeared at once. The nervousness and desire for a moderate amount of morphin persisted for about two weeks. Three-fourths of the wound healed by primary intention. A small part, about one and a half inches in length, posterior to the anus, kept open, but healed within fifteen or twenty days completely. The author mentions his large experience in dissecting out roentgen ray burns from the breast in patients who were taking morphin to relieve the constant pain, and declares that immediately after the operation the pain entirely disappeared and the desire for morphin, in spite of the fact that large amounts had been used for a good many months, disappeared almost entirely with it. Several instructive illustrations accompany the article, and make much clearer the technic of the operation.

The second clinic of special interest to us is one on the treatment of carcinoma of the tongue with radium, by F. G. Dyas. Two hollow gold needles, each containing 35 mg radium, were buried in the lesion of the tongue and allowed to remain six hours. At the same time the cervical glands upon the same side were exposed to intensive radium applications for six hours, and upon the following day for eight hours. The needles were secured in the tongue by heavy linen threads passed through the eyes of the needles. One week later there was evident shrinking of the epithelioma, which had ceased to bleed and which was losing its cauliflower-like appearance. Two weeks from the first application the needles were again inserted for the same length of time as previously, and the same exposure was given to the cervical glands. Several weeks later radical removal of the cervical glands was advised and accepted by the patient. The author, although evidently hopeful of a final favorable outcome, recognizes that the case is still yet in the balance. However, when the safety and comfort of this procedure are contrasted with the mutilating and ineffective resection of one-half of the tongue, he feels that every surgeon should give the radium treatment a thorough trial before resorting to the tongue resection. The reviewer feels that he would not be doing his duty did he not point out that the statements regarding dosage of the "intensive radium applications for six hours" are exceedingly vague, and fail entirely to convey definite data enabling some one else to duplicate the treatment in a similar case, thus making results comparable. The reviewer also feels that the author of this clinic is too optimistic, considering the large number of published cases which have already been subjected to this form of thorough treatment.

J. T. C.